PB82-207481

Blue Creek Watershed Project
Pike County, Illinois

Illinois State Environmental Protection Agency
Springfield

Oct 81

U.S. Department of Commerce
National Technical Information Service
NTIS

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. Recipient's Accession No. PB82-207481

4. Title and Subtitle
Blue Creek Watershed Project
Pike County, Illinois
May 1979-October 1980

5. Report Date
Oct. 1981 (published)

6.

7. Author(s)
Thomas E. Davenport

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Illinois Environmental Protection Agency
Division of Water Pollution Control
2200 Churchill Rd.
Springfield, Illinois 62706

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
Illinois Environmental Protection Agency
2200 Churchill Rd.
Springfield, Illinois 62706

13. Type of Report & Period Covered
May 1979-Oct. 1980

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This report details the background, purpose, and monitoring strategy of the Blue Creek Watershed Project. This report also delineates all studies that are being continued or have been completed that supplement the tributary monitoring.

17. Document Analysis a. Descriptors

soil erosion
nonpoint sources
monitoring
agricultural watersheds
lakes

b. Identifiers/Open-Ended Terms

Blue Creek Watershed, Pike County, Illinois
Agricultural Conservation Program (A.C.P.) Special Water Quality Project
Pittsfield City Lake

c. COSATI Field/Group

18. Availability Statement:
Release unlimited; available from NTIS
Springfield, VA 22161

19. Security Class (This Report)
Unclassified

21. No. of Pages
73

20. Security Class (This Page)

22. Price

(See ANSI-Z39.18) See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

PB82-207481

BLUE CREEK WATERSHED PROJECT

PIKE COUNTY, ILLINOIS

MAY, 1979 - OCTOBER, 1980

Illinois Environmental Protection Agency
Division of Water Pollution Control
2200 Churchill Road
Springfield, Illinois 62706

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

BLUE CREEK WATERSHED PROJECT
PIKE COUNTY, ILLINOIS
MAY, 1979 - OCTOBER, 1980

written by

Thomas E. Davenport

PLANNING SECTION
DIVISION OF WATER POLLUTION CONTROL
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
2200 CHURCHILL ROAD
SPRINFIELD, ILLINOIS 62706
OCTOBER, 1981

TABLE OF CONTENTS

SECTION	PAGE
TABLE OF CONTENTS	i
LIST OF TABLES	iii
LIST OF FIGURES	v
ACKNOWLEDGEMENTS	v
INTRODUCTION	1
BACKGROUND	1
DESCRIPTION OF BLUE CREEK WATERSHED	2
Location	2
Pittsfield City Lake	2
Climate	4
Geology	6
Basin Physiography	6
Topography and Drainage	6
Watershed Soils	7
Land Use	10
Water Use	10
FISHERIES MANAGEMENT	11
MONITORING STRATEGY	11
DESCRIPTION OF MONITORING STATIONS	15
Stations A & B	16
Station C	16
Station D	17
Station E	17
Station F	18
MONITORING METHODS	20
Flow Measurements	20
Water Quality Sampling	20
Laboratory Analyses	22
AGENCY INVOLVEMENT IN THE BLUE CREEK WATERSHED PROJECT	25
Illinois Environmental Protection Agency's Involvement	25
Two Rivers Resource Conservation & Development Area's Involvement	25
Agricultural Stabilization & Conservation Service's Involvement	26
Soil Conservation Service's Involvement	29

CONTENTS (con't)

SECTION	PAGE
BACKGROUND STUDIES AND RESULTS	32
Intermittent Stream Investigation	32
Limnological Summary of Pittsfield City Lake	34
Macroinvertebrate Sampling of Pittsfield City Lake	36
Land Cover/Water Quality Relationships Project	38
Gross Erosion Assessment in the Blue Creek Watershed Pike County, Illinois	40
Stream Geometry and Channel Characteristics	42
Chemical Analysis of Surficial Sediments From 63 Illinois Lakes	48
Sedimentation Survey of Pittsfield City Lake	51
LITERATURE	53
APPENDIX SECTION	54
Appendix 1 -- General Description of the Major Soils in the Blue Creek Watershed	55
Appendix 2 -- Fish Species List For Pittsfield City Lake & Blue Creek Tributary	56
Appendix 3 -- Universal Soil Loss Equation	59
Appendix 4A -- Qualitative Macroinvertebrate Sample Data 1979	61
Appendix 4B -- Qualitative Macroinvertebrate Sample Data 1980	63
Appendix 5 -- Abbreviations and Symbols	64

LIST OF TABLES

TABLE		PAGE
1	Location, physical description and morphometry of Pittsfield City Lake, Pike County, Illinois.	4
2	1979-80 monthly and long term temperature averages in Griggsville, Illinois.	5
3	1979-80 monthly and long term precipitation averages in Griggsville, Illinois.	5
4	Rainfall Intensity -- Frequency for a 6-hour duration event developed from the U.S. Department of Commerce, Weather Bureau, Technical Paper No. 25.	6
5	Land use summary by soil series in the Blue Creek Watershed as of 1979.	9
6	Parameter by frequency for the Blue Creek Project's Water Quality Analysis.	13
7	Parameters Measured Monthly.	14
8	Blue Creek Project Sampling Schedule by frequency and location.	15
9	Land use by acreage for the sub-watershed draining at Station C in the Blue Creek Watershed as of October 1, 1980.	16
10	Land use by acreage for the sub-watershed draining at Station D in the Blue Creek Watershed as of October 1, 1980.	17
11	Past practice, proposed practice and use associated average annual erosion rate.	18
12	Past practices, proposed practices and associated average annual erosion rate by practice for fields in Station F drainage area.	19
13	Summary of monitoring parameters. Sample preservation, methods of analysis, reporting units, and General Use Standards as appropriate.	22
14	List of conservation practices eligible for cost-share in the Blue Creek Watershed as part of the ASCS -- Special Water Quality Project.	28

LIST OF TABLES

(Continued)

TABLE		PAGE
15	Summary of conservation practices implemented in the Blue Creek Watershed as of October 1, 1980.	30
16	Summary of ten selected management alternatives in the Blue Creek Watershed.	39
17	Average bed particle size distribution of sand, silt and clay by sampling location for April 02 & 11; May 16, 10 & 27; and June 13, 1980.	42
18	Mean sediment constituent concentrations of Pittsfield City Lake, 63 Illinois Lakes, and Artificial Central (24 lakes) type Lakes, samples collected in 1979.	49
19	Classification of Illinois Lake Sediments.	50

LIST OF FIGURES

MAPS		PAGE
1	Map of the Blue Creek Watershed in Pike County, Illinois.	3
2	Map of Water Quality Monitoring Stations in the Blue Creek Watershed, Pike County, Illinois.	12
3	Map of Blue Creek Watershed showing location of biological sampling sites.	33
4	Map of Pittsfield City Lake showing locations of three sampling sites.	37
5,6 7,8 & 9	Maps showing the locations of the stream geometry and channel dynamics sampling sites on Blue Creek and its tributary.	43-47
10	Map showing locations of lake sedimentation survey cross sections of Pittsfield City Lake.	52

ACKNOWLEDGEMENT

This project was financed in part with funds from the U.S. Environmental Protection Agency (USEPA) Region V office, Chicago, Illinois under the provisions of Section 208 of the Clean Water Act (PL95-217). The contents of this report do not necessarily reflect the views of the USEPA. Mention of manufactors of equipment does not constitute endorsement for use.

Many individuals and agencies have contributed significantly to the success of this project. The assistance and contributions of William Campbell (ASCS), Curt Dobson (DOC), William McCartney (RC&D), Harry Wright (ICES), Wayne Kinney and Edward A. Johnston (SCS) was appreciated. The coordination, guidance and editorial comments of Robert Clarke, William Rice, Martin Kelly and Kenneth Rogers (IEPA) are gratefully acknowledged.

Portions of this report were taken from reports and material prepared for individual specific activities by Ming T. Lee (ISWS), William Boger (ISWS), William Ettinger, Martin Kelly and Robert Hite (IEPA). This report was typed by Betty Ascher of Word Processing II under the direction of Norma Kraus. Marilyn Budd assisted in report preparation.

INTRODUCTION

The Blue Creek watershed in Pike County, Illinois was selected to demonstrate the effects of erosion control practices upon water quality. Agricultural Stabilization and Conservation Service of the USDA has designated the Blue Creek watershed as an A.C.P. Special Water Quality Project area. The ASCS designation enables the farmers to implement conservation and pollution control practices to improve water quality through financial assistance. The Illinois Environmental Protection Agency (IEPA) has initiated an intensive monitoring program on the watershed to determine the impacts of the applied conservation measures on water quality. Particular emphasis is placed upon evaluation of sediment yield factors and pollutant delivery to the lake.

Evaluation of the proposed implementation program and options is necessary to determine water quality effects which result so that appropriate cost effective control options are recommended. It is anticipated that the information and data from the monitoring of the Resource Management Systems (RMS) will document actual impacts from agricultural practices and aid in refining of strategies for implementation of the State 208 Soil Erosion and Water Quality Program.

The primary objective of the project is to develop the most viable agricultural non-point source (NPS) control strategy, demonstrate it's effectiveness, develop methods to identify water quality problem areas and to determine the best Resource Management System (RMS) controls. Baseline (Water Year Report 1) studies have been initiated to define the actual yield of nutrients, pesticides and soil particles and their impact on downstream water quality. The mode of transport, magnitude, frequency and duration of these materials will be determined and the pollutional impact evaluated.

Background

The Illinois Water Quality Plan (208) states "The most severe agriculture related problem in Illinois is soil erosion resulting in lake sedimentation" (IEPA, 1979). The 208 plan identified eleven high priority lakes for Rural Clean Water Program funding. Lake Pittsfield was ranked priority one. Project selection and Pittsfield City Lake watershed values rankings were based on; the lake's use for both public water supply and recreation, public ownership and access, size of lake (241 acres) and watershed (7,012 acres), land use in watershed, annual capacity loss (1.38%) and water transparency (1.9 ft.). The primary watershed factors considered were annual erosion rates (8.1 tons) and farm animal manure production (405 lbs/ac). Other factors considered were soils, topography, ratio of drainage area to lake capacity, cost of applying BMP's, and potential of the lake for showing improved water quality upon implementation of BMP's. The availability of a nearby alternative water supply was also considered. Water quality studies show that the existing stream and Pittsfield City water supply lake have been impacted.

PURPOSE OF SPECIAL MONITORING & EVALUATION

The primary purpose of the monitoring and evaluation project is to determine the actual yield of pollutants from a variety of agricultural practices to downstream receiving water and its effect upon the water quality and reasonable uses of the water resources. Monitoring and evaluation of actual Resource Management System implementation progress on sub-watersheds and yield of pollutants to the major tributary stream and public water supply lake will allow a reliable comparison of low and high-cost practices and downstream yield reductions, evaluation of cause and effect relationships between a variety of practices, determination of NPS yields for the selection of lands requiring treatment to reduce water quality problems, and assessment of the impact of Resource Management systems on both stream and lake quality.

DESCRIPTION OF BLUE CREEK WATERSHED

Blue Creek Watershed

The Blue Creek watershed consists of 7,012 acres (excluding lake 6,810 acres) in east central Pike County. Land use in the watershed is predominately agricultural.

Location

The Blue Creek watershed, an area of approximately 7,012 (11 mi^2) acres is located in west central Illinois between the Illinois and Mississippi Rivers. Blue Creek drains into Pittsfield City Lake in east central Pike County (Map 1). The lake is located approximately three miles northeast of Pittsfield and five miles south of Griggsville.

Pittsfield City Lake

Pittsfield City Lake was constructed as a multiple purpose reservoir in 1961 under the authority of PL:83-566 funding. The dam built in 1961 is a 650-foot earthfill structure with a 4-foot-square drop inlet spillway at elevation 596 feet above mean sea level (msl). There is also an emergency spillway on the west end of the dam at elevation 604.3 feet above msl (Bogner 1979). It has a mean depth of 12 feet, surface area of 218 acres, and 5.2 miles of shoreline.

The lake is used for recreation, water supply for the City of Pittsfield, and as a flood control structure (IEPA, 1979). Approximately 4,400 people of the City of Pittsfield depend on the lake for a water supply. The Pittsfield water plant pumps an average of 453,380 gallons per day from the lake for domestic use. The major recreational uses of the lake are fishing and boating with camping and picnicking on the adjacent park grounds. Location, physical description and morphometry of the lake are presented in Table 1.

Fig. 1 Map of Pittsfield City Lake watershed

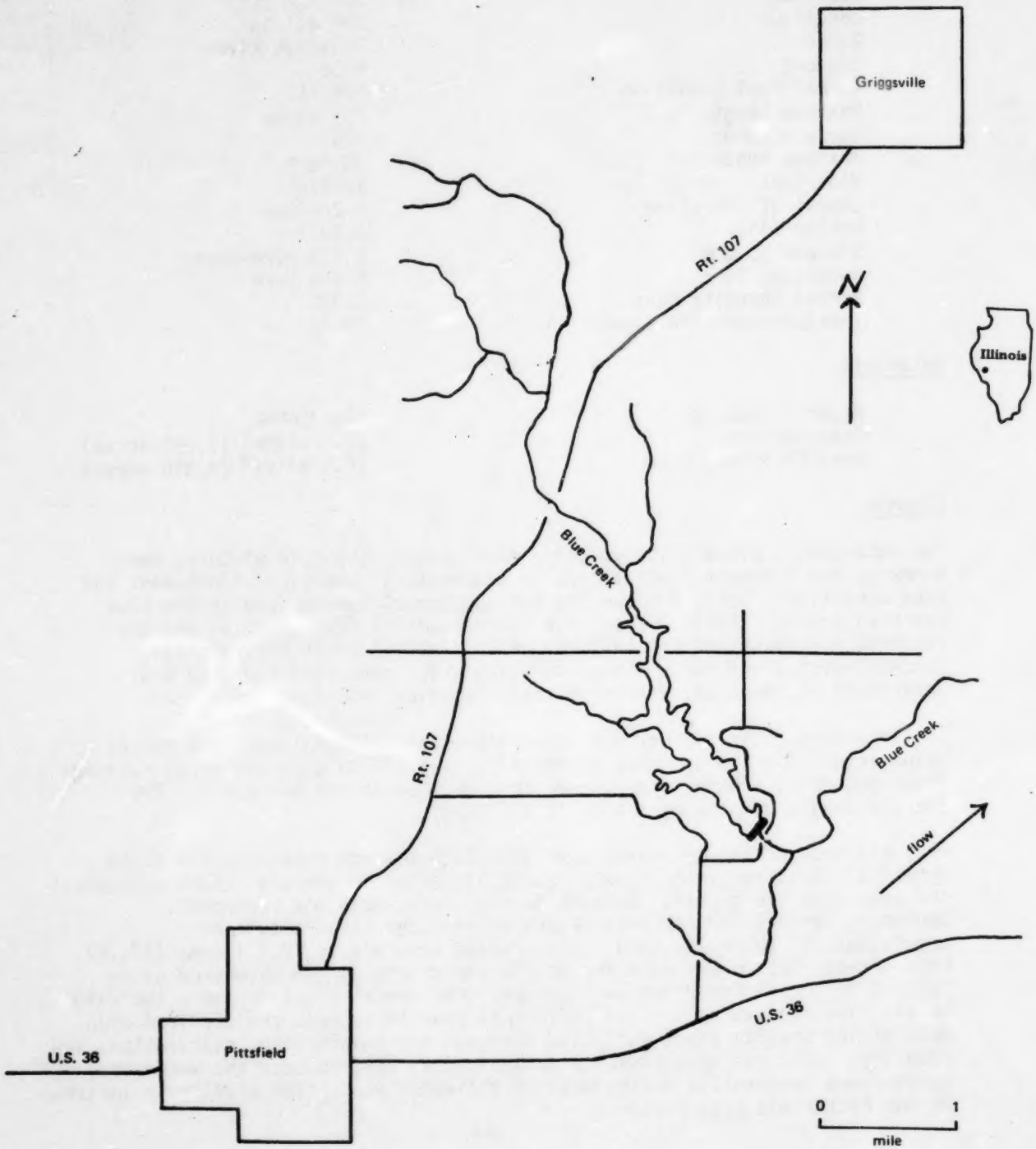


TABLE 1

Location, physical description and morphometry of Pittsfield City Lake, Pike County, Illinois. (IEPA, 1980)

Lake

Latitude	39° 37' 51"
Longitude	90° 44' 46"
Basin	Illinois River
Segment	B-06
Normal Pool Elevation	596 ft.
Maximum Length	1.5 miles
Surface Acres	218
Maximum Depth	32 feet
Mean depth	12 feet
Length of Shoreline	5.2 miles
Bottom Slope	0.3617
Storage Volume	2,773 acre-feet
Retention Time	0.554 year
Annual Capacity Loss	1.08%
Total Accumulated Capacity Loss	19.7%

Watershed

Major Tributary	Blue Creek
Drainage Area	11.0 miles^2 (7,028 acres)
Area Excluding Lake	10.6 miles^2 (6,810 Acres)

Climate

The watershed's climate is typically continental with cold winters, warm summers, and frequent fluctuations in temperature, humidity, cloudiness and wind direction. Table 2 shows the average annual temperature of the Blue Creek watershed. Table 3 shows the average annual precipitation and the recorded precipitation for 1979 and 1980. Table 4 shows the rainfall intensity-frequency for a 6-hour duration event developed from the U.S. Department of Commerce, Weather Bureau, Technical Paper No. 25.

The long term (1941-70) extreme temperatures are 110°(F) above and 25°(F) below zero. The average mean temperature is 53.7°(F) with the first killing frost occurring around late October and the last around mid April. The average length of growing season is 187 days.

Precipitation during the water year 1979-1980 was approximately 25% below normal 37.35 inches (948.75 mm). Annually, rainfall usually occurs throughout the year with the greatest amounts in May, June, July and September. December, January and February generally have the least amount of precipitation, generally snow. The average snowfall is 22.5 inches (571.47 mm). Precipitation was measured at five locations on the watershed using Belfort Universal Recording rain gauges. For annual precipitation, the values of all five are averaged. The individual station records are utilized when determining spatial storm variation for soil erosion/sediment calculations and modeling. IEPA has established a meterological station near the watershed; however was inoperative during most of the water year. The station is located at the Pittsfield City Airport.

TABLE 2

Water Year 1979-80 monthly and long-term (1941-70) temperature averages measured in Griggsville, Illinois. (Degrees Fahrenheit)

	NORMAL	1979-80
	(0)	(0)
October	57.8	56.8
November	43.1	42.2
December	31.5	35.1
January	27.4	31.0
February	31.8	24.0
March	40.6	38.0
April	54.4	52.0
May	64.4	63.0
June	73.3	71.0
July	77.0	79.0
August	75.4	75.0
September	68.0	66.0
Average	53.7	52.7

TABLE 3

Water Year 1979-80 monthly and long-term (1941-70) precipitation averages measured in Griggsville, Illinois.

	NORMAL (Griggsville Station)		1979-80 (Watershed Stations Average)	
	(in)	(mm)	(in)	(mm)
October	3.18	80.77	1.52	38.60
November	2.23	56.64	1.88	47.75
December	1.9	48.26	2.75	69.85
January	1.64	41.65	.25	6.35
February	1.60	40.64	.05	1.27
March	2.82	71.62	3.83	97.28
April	3.87	98.29	2.1	53.34
May	4.39	111.50	4.32	109.72
June	4.55	115.57	2.54	64.51
July	4.24	107.69	1.37	34.79
August	3.29	83.56	4.11	104.39
September	3.64	92.45	3.74	94.99
Annual	37.35	948.75	28.46	722.84

TABLE 4

Rainfall amount and frequency for a 6-hour duration event developed from the U.S. Department of Commerce, Weather Bureau, Technical Paper No.25.

Year Frequency	Inches	(mm)
100	5.48	139.18
50	4.88	123.92
25	4.18	106.15
10	3.46	87.86
5	3.00	76.18
2	2.10	53.33
1	1.24	31.49

Geology

The entire watershed is underlain by limestone of the Keokuk-Burlington formation of the Mississippian system, and is between the Central Lowland Province and the Ozark Plateau Province. This formation exhibits the characteristic fissured and cavernous limestone.

The Nebraskan, Kansan and Illinoian stages of Pleistocene glaciation advanced over the watershed area. These advances resulted in a thin strata of till and outwash material being deposited on the watershed. The Nebraskan and Kansan deposits were severely eroded by the Illinoian advance and at the present time occur only in depressions in the limestone surface. Post-glacial erosion has reduced the Illinoian deposits to remnant mantles which occur only on the upland areas. Farmdale and Peorian loess deposits ranging from eight to twenty feet in thickness overlay the glacial deposits on the upland areas.

Basin Physiography

The Blue Creek watershed is physiographically located in the transition zone between the Till Plains Section of the Central Lowland Province and the Lincoln Hills Section of the Ozark Plateaus Province. The topographic expression of the area differs from that of the Lincoln Hills only because of presence of thicker glacial drift.

Topography and Drainage

The topography of the Blue Creek watershed is characterized by gently rolling hills and a few level ridge tops. The watershed is drained by numerous small tributaries. The gradients of the main stream and its tributaries are moderate. The short tributary channels are generally "V"-shaped, and bordered by steeply sloping land.

The maximum elevation, 785 feet, occurs in the northwestern edge of the watershed. The elevation at the spillway is 596 feet while the lowest elevation of the lake is 564 feet, giving a maximum watershed relief of 221 feet.

There are no known muncipal or industrial wastewater discharges to the Blue Creek watershed upstream from Pittsfield City Lake.

Watershed Soils (IEPA, 1980)

The majority of the upland soils in the Blue Creek watershed were formed in moderately thick loess that overlies glacial till of Illinoian Age. This area is highly susceptible to erosion. Soil losses from the gentle to steep slopes contribute large amounts of sediment to downstream water courses and the Pittsfield City Lake. Table 5 shows land use/cover by soil series in the Blue Creek watershed.

Most of the soils were formed under hardwood forest vegetation. The light-colored soils formed under forest vegetation are classified as Alfisols. Alfisols have light-colored surface layers, or, if the surface layer is dark, it is less than 10 inches thick. These surface layers must also have less than 1 percent average organic matter content thoughout their total thickness. Some small areas located in the northern part of the watershed were formed under prairie grasses. Soils formed under grass vegetation are dark-colored and classified as Mollisols. Not only must the surface layer be dark colored and average more than 1 percent organic matter throughout, but the dark-colored layer must be at least 10 inches thick, unless the total soil is very thin, and it must have sufficient soil structure so that it is not both massive and hard or very hard when dry. Mollisols may vary widely in texture, permeability, degree of subsoil development, and many other properties. Soils on the steep sloping areas near the streams formed either in weathered glacial till or limestone residium. The soils on bottom lands consist chiefly of deposits derived from erosion in the uplands and are mainly silty.

The Tama-Muscatine-Downs association consists of deep, dark colored, well to somewhat poorly drained soils on uplands, occurring at the extreme upper end of the watershed. They make up approximately 10% of the drainage area. These soils are subject to moderate erosion. They are level to moderately sloping (0-7%) and moderately to highly productive. The main hazards affecting management of these soils are erosion on side slopes and wetness on level areas not adequately drained with tile. Soils in this association are well suited for all land uses.

The Fayette-Rosetta association consists of deep, light colored silt loam soils with moderate to severe erosion. They are gently sloping to steep (2-30%). They make up approximately 38% of the watershed area. The main hazards affecting management of these soils are water erosion and the steep slopes when left unprotected. Organic matter content is low and available water capacity is high. All the soils in this association are well suited for woodland or wildlife land. The gently sloping ridges between the drainage ways are well suited for all uses.

The Clinton-Keomah association consists of deep, light colored soils with moderate to severe erosion. They are gently sloping to steep (3-30%). Keomah soils are nearly level and gently sloping. Soils in this association make up approximately 42% of the drainage area. The main hazards affecting management are water erosion and seepage on side slopes. Wet spots of an acre or less are common on side slopes. Organic matter content is low and available water capacity is high.

The soils that occur on less sloping areas are well suited for cropland, woodland and wildlife land.

The Haymond-Wakeland association consists of deep, light colored, level to gently sloping (0-4%) soils on bottomlands. These soils make up approximately 10% of the drainage area. The main hazards affecting management of the soils are wetness, flooding and deposition of sediments from streams and nearby valley side slopes. Organic matter content is generally low. Available water capacity is high. All the soils in the association are well suited for wildlife, woodland and cultivated crops if adequately drained (USDA, 1977). Detailed soil series information for the major soil series is listed in the Appendix Section.

TABLE 5

Land use summary (in Acres) by soil series in the Blue Creek Watershed (1979).

Land Use Category	Clinton	Fayette	Rozetta	Downs	Hickory	Atterberry	Muscatine	Tama	Orion	Clarksdale	Keomah	Other	Total	Percent Total
Pasture/Hayland	357	480	51	26	38	16	5	8	57	-0-	9	35	1,082	15.4
Row Crop (Includes Farmstead)	1,784	1,172	444	385	93	146	134	142	113	74	34	96	4,622	65.7
Woodland	231	524	20	1	50	-0-	-0-	-0-	69	-0-	1	68	964	13.7
Orchard	57	3	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	1	61	0.9
Water-Wetland-Wildland	11	15	3	2	3	-0-	-0-	-0-	2	-0-	2	261	299	4.3
TOTAL	2,440	2,194	522	414	184	162	139	150	241	74	47	461	7,028	

Land Use

The land use of the Blue Creek watershed is predominately agricultural, cropland 65.8%, pasture 15.4%, woodland 13.7%, water/wetland 4.3% and orchards 0.8% (IEPA, 1980). Most dominate crop rotations are corn/soybean and corn/soybean/wheat (grain), there is a small amount of the watershed in continuous corn. There are approximately 460 acres of hog and cattle feedlots on 21 different farms. It has been estimated that erosion resulting from the operations of these feedlots could contribute as much as one-third of sediment entering into Pittsfield City Lake.

Water Use

The Pittsfield water plant pumps from 399,761 to 507,000 gallons per day from the lake for domestic use. Approximately 4,400 people of the City of Pittsfield depend on the lake for a water supply. Pittsfield water users consist of 22 large customers (50,000 to 381,000 gallons/month); 1,778 commercial and residential users.

The water user's by volume of the Pittsfield water supply are predominately residential (60%) and commercial (32%) with remainder being used by industry (8%).

FISHERIES MANAGEMENT (IEPA, 1980)

At least fifteen species of fish are known to exist in Pittsfield City Lake (Appendix). The most recent fish survey was conducted in October, 1979 by the Illinois Department of Conservation. Results of that survey showed that, white crappie, gizzard shad and bluegill were the most abundant species, although most individuals were thin and slow growing. During the spring of 1978 and 1979, an experimental hatchery project was initiated to improve the largemouth bass population. A small cove (one acre) was blocked off from the main lake and the fish were removed. Breeder bass from 1 to 5 pounds were stocked in the cove. A estimated 10,000 to 13,000 fingerlings per year can be produced from this hatchery. Prior to these efforts, only 10 percent of the bass population were young-of-the-year. However, in 1978, this proportion increased to 24 percent and by 1979 was 36 percent. Moreover, the first year spawn carried over as yearlings during 1979, accounting for 31 percent of the total bass collected.

A fish population census was conducted in July, 1980 on Blue Creek and its tributary. Nine species of fish were collected on Blue Creek with minnows comprising six of them. The creek chub was predominant species, several bullheads and a young-of-the-year largemouth bass were also captured.

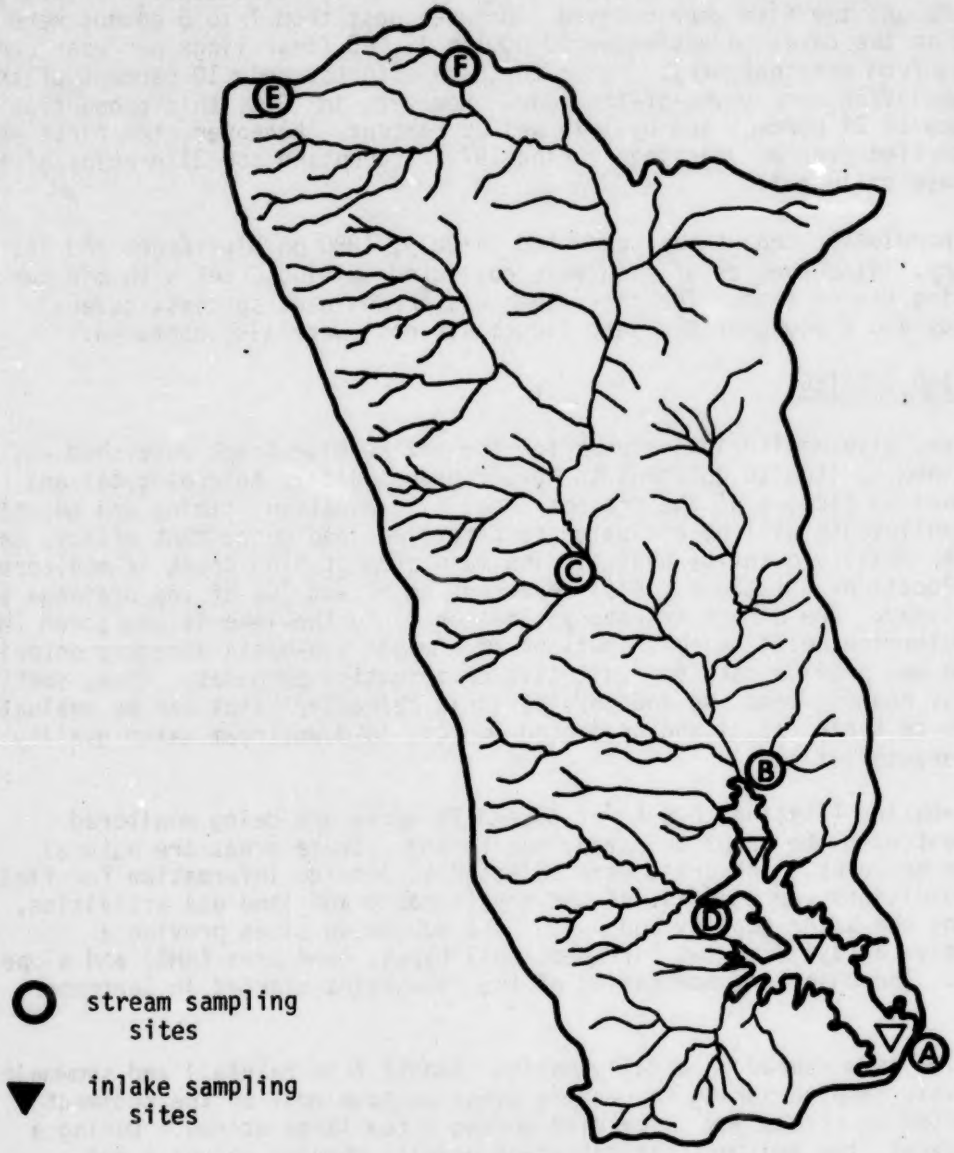
MONITORING STRATEGY

A comprehensive monitoring network for the entire Blue Creek watershed was established by IEPA to document the basic hydrological, meterological and water quality factors of the project area. The duration, timing and quantity of NPS pollutants will be evaluated to determine land management effects on the water quality/quantity budget. The main stem of Blue Creek is monitored at two locations (Stations B & C) representing 50 and 70% of the drainage area respectively. One direct tributary (Station D) to the lake is monitored (Map 2) to determine relative contributions of a major sub-basin directly entering the lake and provide data for unit size contribution purposes. Thus, spatial patterns, routing land use and physiographic characteristics can be evaluated relative to their actual and projected impacts on downstream water quality and lake characteristics.

Two sub-basins (Stations E & F) of 40 and 79 acres are being monitored concurrent with the major tributary monitoring. These areas are natural drainage networks. The areas were selected to provide information for field level conditions representive of the physiography and land use activities, impacting the water quality and uses. The sub-basin sites provide a comparative analysis of two different soil types, land uses (RMS) and slope classes. The base-line monitoring of the sub-basins started in September, 1980.

Streamflow is measured on a daily basis. Runoff from rainfall and snowmelt is intensively sampled during the entire event because most of the sediment transported by streamflow is carried during a few large storms. During a runoff event, the sediment concentration usually changes abruptly and increases significantly with higher flows. The frequency and timing of intensive water quality sampling is keyed to storm events.

Figure 2. Map of Water Quality Stations in the Blue Creek Watershed in Pike County, Illinois



Sample analyses for chemical parameters in the tributary water quality monitoring will be identical to those in lake water quality monitoring. This allows nutrient budgets to be estimated for the monitored parameters. A complete parameter listing by station and sampling frequency is presented in Tables 6, 7 and 8.

TABLE 6 -- Parameter sampling frequency for the Blue Creek Project's Water Quality Analysis.

PARAMETER/FREQUENCY	DAILY	WEEKLY	EVENT
Total Suspended Solids	X	X	X
Total Volatile Solids	X	X	X
Ammonia-Nitrogen		X	
Total Kjeldahl Nitrogen		X	X
Total Phosphorus		X	X
Nitrite & Nitrate		X	
Dissolved Phosphorus		X	
Biological Oxygen Demand		X	
Chemical Oxygen Demand		X	X
Iron		X	
Potassium		X	

TABLE 7 -- Parameters Measured Monthly
(Organics, Metals & Hg^{+2})

ICAP	ORGANICS
Barium	Aldrin
Boron	Chlordane
Cadium	DDT
Copper	Endrin
Iron	Heptachlor
Lead	Heptachlor epoxide
Managanese	Lindane
Nickel	Methorychlor
Silver	PCB's
Zinc	
Beryllium	
Calcium	
Cobalt	
Lithium	
Magnesium	
Potassium	
Sodium	
Strontium	
Vanadium	
Mercury (Not ICAP)	

Table 8: Blue Creek Project Sampling Schedule by frequency and location for chemical parameters. Refer to map 2 for sampling location and Table 6 for a list of parameters by frequency.

FREQUENCY/SAMPLING LOCATIONS	A	B	C	D	E	F	LAKE SITES	COMMENTS
Daily		X	X					
Monday & Friday	X							
Weekly	X	X	X					Sample day is Wednesday.
Event	X	X	X	X	X	X		Station A is sampled twice daily 6 consecutive days after a storm.
Monthly Metals (ICAP)		X	X				X	
Monthly Organics		X	X				X	
Monthly							X	

Biological monitoring is also necessary for a complete analysis of the impacts on water quality of RMS's implementation. There are three biological monitoring sites in the watershed (Map 3). Biological monitoring includes macroinvertebrate collections, used as indicator organisms of water quality improvement or degradation. An abstract of the report covering this aspect of the Blue Creek Watershed project is in the Background Studies and Results Section.

The Lake was monitored at three locations (refer to map 4) to determine water quality and subsequent impacts of RMS's implemetation. An abstract of the results of the May-October 1979 monitoring effort is included in the Background Studies Section. The lake was also sampled intensively during the 1979-1980 water year.

The Illinois State Water Survey, under contract from IEPA, is carrying out the stream geometry and channel characteristic element of the overall Blue Creek Watershed Project. This element will consist of two parts: 1) monitoring channel dynamics, and 2) analyzing particle size distribution of bed material at certain stream locations after rainfall events. An abstract of this activity is included in the Background Studies Section.

Computer-based modeling techniques, were used to estimate erosion rates for the entire watershed and assess effects of a variety of RMS. A non-point source screening model will be run on the entire basin. The screening model is based on the Universal Soil Equation (USLE) for estimating potential soil erosion. This modeling effort is in 2 phases; 1) watershed scale where general factors were utilized; and 2) field level scale where existing and potential management scenarios were run. A pollutant transport model is used during both phases of modeling effort. This model is applied for specified storm events and is calibrated with data obtained by the monitoring efforts. An abstract of the watershed level phase is enclosed in the Background Studies Section.

DESCRIPTION OF MONITORING STATIONS

Brief descriptions of the individual monitoring stations are presented below. Refer to map 2 for the location of the monitoring stations.

Stations A & B

Station A, the spillway, samples outflow of the lake. The drainage area is 7,029 acres including the lake.

Station B's drainage area is approximately 70% (4,858 acres) of the Blue Creek Watershed. It is located at the upper end of the lake on Blue Creek, this point characterizes the major lake inflow. Upstream of the causeway at Station B, sedimentation occurs due to the causeway flow restriction and backwater effects.

Sampling schedules and parameters monitored for Stations A & B are listed in Tables 6 and 8.

Station C

Station C is located at the highway 107 bridge crossing Blue Creek. The most comprehensive sampling in the project area is conducted at this site. Streamflow is measured at Station C. Sampling frequency is daily, weekly and event related. The sampling schedule and parameters monitored are listed in Tables 6, 7 and 8.

This sub-watershed drains approximately 50% (3,272 acres) of the Blue Creek Watershed. Land use by acreage in this sub-watershed is presented in Table 9. In general, the relative proportion of each use is similar to the overall land use in the entire project area. Pasture and cropland comprise nearly 80 percent of the use with over two-thirds of the total in row crop production. Feed lot acreage is listed both under the woodland and farmstead land use category depending upon the type of operation.

TABLE 9

Land use by acreage for the sub-watershed drainage area to Station C in the Blue Creek Watershed as of October 1, 1980.

LAND USE	ACREAGE	Percent Total
Cropland	1,889	57.7
Pasture/Hayland	743	22.7
Woodland	186	5.7
Wildland	238	7.3
Farmstead	18	0.6
Other	198	6.0
TOTAL	3,272	

Station D

Station D is located on the western side of Pittsfield City Lake. Runoff resulting from rainfall-events and snowmelt is sampled at Station D. Parameters monitored are listed in Tables 6 & 8.

Land use in the lowlands is predominately woodland and pasture with rowcropping dominate on the sloping lands and ridgelands. There are three feedlot operations in this sub-basin. The drainage area of this sub-watershed is 470 acres. It drains directly into the lake.

TABLE 10

Land use by acreage for the sub-watershed drainage area to Station D in the Blue Creek Watershed as of October 1, 1980.

LAND USE	ACREAGE	Percent Total
Cropland	248	52.7
Woodland	142	30.2
Pasture	80	17.1
TOTAL	470	

Station E*

Station E is located in the northwestern part of the watershed. Runoff resulting from rainfall-events and snowmelt is sampled at Station E. The parameters monitored for are listed in Table 6:

Station E consists of one 40 acre field draining into an unnamed channel. Table 11 lists the past practice, present practice and the average annual erosion rate by practice. The present practice has reduced averge annual erosion by 40%. This soil loss is still approximately 3 times the allowable maximum soil loss per acre tolerance loss (T) a given soil may experience and still maintain its productivity over an extended period of time as defined by the Soil Conservation Service.

*Station E orginally was located in the southwest part of the watershed, but due to monitoring difficulty it was moved to its present location.

TABLE 11

Past practice, proposed practice and the associated average annual erosion rate by practice for Station E's drainage area.

SIZE (acres)	$\bar{X}$ ANNUAL EROSION RATE* (TONS/ACRES)	
		PAST PRACTICE
40	24 Tons	C-Sb Rotation Spring Plow Up & Down the Slope
		PROPOSED PRACTICE
	14.5	C-S6-6r Rotation Chisel Plow in the Fall Disk Twice & Plant; 1-2000 lbs. Residue Left on the Ground

*Calculated using the USLE C; Corn, Sb; Soybean, Gr; Wheat

Station F

Station F is located in the northern part of the watershed. Runoff resulting from rainfall events and snowmelt is sampled at Station F. The parameters sampled for are listed in Table 6:

Drainage area of Station F consist of 79 acres draining four different fields. Table 12 lists the past and proposed practices and the average annual erosion rate by practice for each field. The implementation of proposed practices will reduce average annual erosion by 77%. The resulting soil loss is below the maximum allowable soil loss tolerance per acre (T).

TABLE 12

Past practices, proposed practices and the associated average annual erosion rate by practice for field in Station F drainage area.

FIELD NUMBER	SIZE (acre)	$\bar{X}$ ANNUAL EROSION RATE* (TONS/ACRE)	PAST PRACTICES
#2	14.6	19-20	C - Sb Rotation Spring Plow Across the Slope or Disk - Chisel - Disk Twice - Plant
#3	19.8	10-11	C-Sb-Gr-4 yrs Grass Rotation -- Spring Plow Across the Slope
#4	34.1	19-20	C - Sb Rotation Spring Plow Across the Slope or Disk - Chisel - Disk Twice - Plant
#5	10.0	30-33	C - Sb Rotation Spring Plow Across the Slope or Disk - Chisel - Disk Twice - Plant
			Proposed Practices
#2	14.6	4.5-5.0	C-Sb-Gr Rotation Conservation Tillage 1-2,000 lbs. Residue on the Contour
#3	19.8	3.5-4.5	C-Sb-Gr-7 Yrs. Grass Rotation -- Conservation Tillage 1-2,000 lbs. Reside
#4	34.1	4.5-5.0	C-Sb Rotation Conservation Tillage 1-2,000 lbs. Residue on the Contour
#5	10.0	4.5-5.0	C-Sb Rotation Conservation Tillage 1-2,000 lbs. Reside on the Contour with Grassed Back Slope Terrace

*Calculated using the USLE C; Corn, Sb; Soybean, Gr; Wheat

MONITORING METHODS

Methods used for field and laboratory procedures are those accepted for agricultural related hydrology research. Analytical techniques are documented.

Flow Measurements

There are four automated flow gauging stations installed in the Blue Creek Watershed. The two major streamflow gauging stations (C + D) consist of stilling wells, (diameter; Station C, 24 in; Station D, 18 in) and a Leopold Stevens water level recorder. The two field runoff gauging stations (E & F) have a 3.0' H- Flume and a watch dog type Leopold Steven water level recorder. The Leopold-Stevens instruments record the level (stage) of stream water surface continuously on a strip chart. These strip charts are digitized by the Illinois State Water Survey (ISWS) for subsequent analysis.

Stream discharge at Station C is estimated as a function of stage based measured discharge, using a velocity current meter (Holton et al., 1968) during time of known stage. The stream stage was continously measured starting in November, 1979 at Station C. At Station D, direct streamflow measurement is not feasible. This site has three parallel 66-inch corrugated pipes. Because of this situation an indirect method of USGS will be utilized to estimate stream discharge. Station D was not fully operational before October 1, 1980. At Stations E and F, the flumes are rated H- flumes and as such, the discharge hydrographs can be estimated directly from published rating curves and recorded stage data. Stations E and F became operational in September 1980.

The overflow of Pittsfield City Lake is monitored at the spillway, Station A (map 2). The lake level is recorded once a day by the water plant operator. These readings are used in conjunction with the spillway rating curve to estimate lake outflow. Streamflow entering the lake at Station B will be estimated by extrapolation of streamflow at Station C.

Water Quality Sampling

Water quality monitoring was initiated in May 1980. Four ISCO automatic water samplers (model 1680) and one Sigma automatic device sampled streamflow during runoff events. The ISCO samplers and intakes were located at gauging stations C, D, E and F. At Stations C and D, the samplers were programed to collect 250 millileters (ml) of streamflow each 7 1/2 minutes, compositing two samples per bottle. Each sampler would collect 7 1/2 minute samples for a 7-hour period once started. At Stations E & F, the samplers were programed to collect 250 ml of streamflow each 7 minutes, compositing two samples per bottle. Each sampler would collect 7 minute samples for a 6.5 hour period once started. The Sigma sampler was located next to the dam spillway (Station A) to sample lake outflow resulting from storm or snowmelt events. Due to mechanical problems, Station A is now sampled manually twice a day for six days after rainfall events.

Electrical triggering devices initiates sample collection by activating each automatic water sampler when the water level reached a predetermined stage which varied by location. Stages were selected which would allow the complete runoff event at that location to be sampled. However, the duration of some runoff events exceeded the sampler capacity or mechanical problems with the sampler, prevented sampling of the complete hydrograph.

Weekly, daily and monthly samples at Stations A, B, and C were collected using a hand-held bottle or weighted bottle holder as appropriate, and composited in a churn sample splitter in accordance with established IEPA procedures (Walton, 1979).

Samples collected by the ISCO automatic water sampler are drawn by a peristalic pump through 1/4 inch, (T.D.) tygon tubing that extends from each sampler to the thalweg (deep spot) of the stream course being sampled. Before and after the sample is taken, the pump air purges the suction line, thus minimizing the possibility of cross section contamination. The weighted polypropylene strainer at the end of each suction line is suspended into the stream from an overhead guiding device.

A major drawback of the suspended sediment sampling procedures is that they do not permit sampling close to the streambed. Currently available suspended-sediment samplers only collect water samples from the surface to a point about 0.3 to 0.5 feet above the bottom. These samplers and sampling procedures do not allow the sampling of the layer of streamflow closes to the bottom which is carrying the greatest concentration of coarse particles. Therefore, bedload is not measured in this water quality study.

Bedload is being measured as part of the stream geometry and channel characteristic component of the watershed evaluation project.

Water samples sent to the laboratory for routine analyses were collected in plastic bottles with appropriate preservative (Table 13). Pesticides and polychlorinated biphenyls (PCB's) samples were collected with specially prepared quart bottles using methods described above and composited directly into a one gallon glass bottle. Fecal coliform samples were collected in specially prepared glass bottles.

Dissolved oxygen, temperature, pH, and conductivity were measured by a meter in the field. Water temperature and dissolved oxygen concentrations were determined at each station using a Yellow Springs Instruments (YSI) Model 57 dissolved oxygen meter. The pH was measured with a Sargent-Welch Model PBC pH meter. Specific conductance was measured using an Electrolytic Conductivity Measuring Set, Model MC-1, Mark V Conductivity meter, manufactured by Kent Electronic Instruments Limited (Chestsey, England). All meters were calibrated in the field consistent with the Agency Field Methods Manual (Walton, 1979).

Laboratory Analyses

All samples requiring laboratory analysis were placed on ice in the field upon collection. Upon arrival at the regional field office, samples were refrigerated and sent to the appropriate IEPA lab. A complete list of parameters sampled or during the Blue Creek Watershed study, testing facilites, and summaries of specific analytic procedures are provided in Table 13.

TABLE 13 -- Summary of monitoring parameters. Sample preservation, methods of analysis, reporting units, and General Use Standards as appropriate.

PARAMETER	SAMPLE CONTAINER	PRESERVATION	METHOD OF ANALYSIS (REFERENCE)	UNITS OF MEASUREMENT	DETECTION LIMITS	ANALYSIS	GENERAL USE STANDARD
Temperature			In situ determination using Yellow Springs Instruments (YSI) model 57 dissolved oxygen meter (1).	^{o}C	nearest 0.1^{o}	Field determination	
Dissolved Oxygen (DO)			In situ determination using YSI model 57 dissolved oxygen meter (1).	mg/l O_2	0.1 mg/l	Field determination	not less than 5 mg/l
Transparency			Secchi disk (2).	feet	nearest 0.1 foot	Field determination	
Total Suspended Solids (TSS)	1/2 gallon polyethylene	refrigeration at 4^{o}C	Filtration on glass fiber filter, determination of increase in weight upon drying at 103-105^{o}C(3, p.268).	mg/l TSS	1 mg/l	Regional IEPA lab	
Volatile Suspended Solids (VSS)	1/2 gallon polyethylene	refrigeration at 4^{o}C	Loss in weight of TSS filter upon ignition at 559^{o}C (3, p.2272).	mg/l VSS	1 mg/l	Regional IEPA lab	
Turbidity	1/2 gallon polyethylene	refrigeration at 4^{o}C	Nephelometrically using Hach model 2100A turbidimeter (3, p.205).	NTU	0.05 NTU	Regional IEPA lab	
Conductivity			YSIU Model 33 S-C-T Conductivity meter or Electrolytic Conductivity Measuring Set, Model MC-1.	umhos/cm	nearest 1 umhos/cm	Field determination	
Alkalinity			Titration of 10 ml sample with 0.02 N H_2SO_4 to phenolphthalein and brom cresol green-methyl red end points (4).	mg/l $CaCO_3$	nearest 5 mg/l	Field determination	

PARAMETER	SAMPLE CONTAINER	PRESERVATION	METHOD OF ANALYSIS (REFERENCE)	UNITS OF MEASUREMENT	DETECTION LIMITS	ANALYSIS	GENERAL USE STANDARD
pH			Sargent-Welch model PBL pH meter, calibrated in field.		nearest 0.1 units	Field determination	in range 6.5 - 9.0
Nitrate + nitrite-N (NO_3+NO_2-N)	8 oz. polyethylene	10 ml - 20% H_2SO_4/l at 4°C	Cadmium reduction method on Technicon Auto-Analyzer (3, p.201).	mg/l N	0.01 mg/l	Regional IEPA lab	
Ammonia-N (NH_3-N)	8 oz. polyethylene	10 ml - 20% H_2SO_4/l at 4°C	Phenate method on Technicon AutoAnalyzer (3, p.168).	mg/l N	0.01 mg/l	Regional IEPA lab	1.5 mg/l
Total Kjeldahl-N	8 oz. polyethylene	10 ml - 20% H_2SO_4/l at 4°C	Digestion at 370°C followed by determination of ammonia as above.	mg/l N	0.1 mg/l	Champaign IEPA lab	
Total Phosphorus (TP)	8 oz. polyethylene	10 ml - 20% H_2SO_4/l at 4°C	Digestion to convert all phosphorus forms to orthophosphate followed by determination using ascorbic acid reduction method using Technicon AutoAnalyzer (3, p.256).	mg/l P	0.01 mg/l	Regional IEPA lab	
Total Dissolved Phosphorus (TDP)	1 oz. polyethylene	10 ml - 20% H_2SO_4/l at 4°C	Field filtration followed by TP analysis as above.	mg/l P	0.01 mg/l	Regional IEPA lab	0.05 mg/l
Fecal Coliform	6 oz. glass	1 ml - 10% $Na_2S_2O_3$/l	Filtration of sample through 0.45u membrane filter followed by incubation for 24 hrs. at 44.5°C on pad containing M-FC culture media (6, p.937).	#organisms per/100ml	1/100 ml	Regional IEPA lab	200/100ml
Total Mercury (Hg)	6 oz. glass	20 ml - 25% $K_2Cr_2O_7$ in 50 % HNO_8/l	Digestion with H_2SO_4 and potassium persulfate to convert all forms to inorganic Hg followed by stannous chloride reduction step to convert all inorganic Hg to metallic Hg, then measurement by cold vapor atomic absorption (3, p.127).	mg/l Hg	0.05 mg/l	Champaign IEPA lab	0.5 mg/l

PARAMETER	SAMPLE CONTAINER	PRESERVATION	METHOD OF ANALYSIS (REFERENCE)	UNITS OF MEASUREMENT	DETECTION LIMITS	ANALYSIS	GENERAL USE STANDARD
Total Metals (Pb, Cu, Fe, Zn, Mn, Cd, Cr)	quart polyethylene	20 ml - 50% $HNO_3/1$	Soft digestion with hot dilute $HCl-HNO_3$ with analysis by direect aspiration atomic absorption (3, p.78).	ug/l elemental metal	50 ug/l (Pb) 10 ug/l (Cu, Fe, Mn) 5 ug/l (Zn, Cd, Cr)	Champaign IEPA lab	20 ug/l Cu 50 ug/l Cd 100 ug/l Pb 1000 ug/l Mn, Fe, Zn
Organics (Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Heptachlor epoxide, Lindane, Methoxychlor, PCB's)	quart glass	benzene rinsed	Determination by gas chromatography	ug/l organic compound	0.1 ug/l PCB's, 0.05 ug/l Methoxychlor, 0.02 ug/l Chlordane, 0.01 ug/l remainder	Springfield IEPA lab	(8)

[1]Walton, H. 1979.
[2]Welch, P.S. 1948.
[3]USEPA. 1974.
[4]Hach. undated.
[5]USEPA. 1979.
[6]APHA. 1975.
[7]ASTM. 1977.
[8]IPCB. 1977. Chapter 3.

AGENCY INVOLVMENT IN THE BLUE CREEK WATERSHED PROJECT

Various State, Federal and the City (i.e., water plant) agencies are involved in the Blue Creek Watershed Project. Brief descriptions of their activities and involvement are in the following sections.

The Illinois Environmental Protection Agency (IEPA) is monitoring the water quality impacts of land treatment in cooperation with the Agricultural Stablilization and Conservation Service and Soil Conservation Service's activities. The Illinois State Water Survey is under contract by IEPA to assist in the monitoring efforts.

The Illinois Cooperative Extension Service (ICES) and the Illinois Department of Conservation (IDOC) are intricately involved in the Blue Creek Watershed Project. IDOC provides technical assistance to the land owners and provided the fisheries management information. ICES promotes conservation on the watershed thru educational efforts.

Illinois Environmental Protection Agency's Involvement

The Illinois Environmental Protection Agency (IEPA) with funding from Section 208 funding of the Clean Water Act is monitoring the impacts of land treatment implementation upon water quality draining the Blue Creek watershed. IEPA's comprehensive monitoring program is described in the monitoring strategy, stations and methods sections of this report. The tributary water quality monitoring program did not begin until May 1980. IEPA instituted an intensive study of Pittsfield City Lake in 1979. Samples for chemical, physical and biological analyses were collected from the lake by IEPA on a monthly basis from May 5 through October 29, 1979 and June 5 through December 3, 1980.

In July, 1979 a full-time water quality specialist was hired to work in the Blue Creek watershed. An IEPA field office was established in Griggsville, Illinois during November, 1979. The Agency's representative is responsible for the tributary sampling program and assisted in sampling the lake and the intermittent stream investigation.

Two Rivers Resource Conservation and Development Area's Involvement

The Resource Conservation and Development Program (RC & D) is administered by the Soil Conservation Service of the United States Department of Agriculture (USDA-SCS). The RC & D Program is to provide technical and financial assistance for the purposes of soil and water management for agriculture related pollution control and for water quality management. RC & D assistance is available only within authorized RC & D areas and only to eligible sponsors (units of government, etc.). The Blue Creek watershed is within the Two Rivers RC & D area. The Two Rivers RC & D's role since 1974 has primarily been working with the Blue Creek Watershed Steering Committees and helping write the various applications for funds.

In March of 1974, the Pike County Soil & Water Conservation District submitted an application for assistance to the Two Rivers RC & D Council. This application requested help from the RC & D program in seeking financial and/or technical assistance for solving problems in the Blue Creek Watershed. The problems cited in 1974 were erosion and sedimentation in the lake.

An Environmental Assessment was completed and forwarded to the Admininstrator of the SCS. In 1975, permission was received to develop a Measure Plan to consist of strategies for 1) critical area treatment and 2) agriculture related pollutant control. The Local Steering Committee included animal waste control.

Throughout 1975 and 1976 a Measure Plan for the Blue Creek Watershed was developed. This plan sets forth the sponsors objectives, a brief description of the resource, a listing of the work to be accomplished, and the funding source.

The Measure Plan was submitted to Lincoln, Nebraska, and to Washington, D.C. offices, for review and approval. In January 1977, the Measure Plan was denied approval because the scope of work was not consistent with regulations. The regulations required that protected areas be maintained in trees, shrubs, and permanent grass, whereas the Measure Plan recommended improvements applied to cropland. In reference to the agriculture related pollutant control, the review interpreted this as an erosion control problem rather than controlling animal waste problems.

The project sat dormat until the fall of 1977. It was then submitted as a proposed project for the Model Implementation Program administered jointly by the USDA and USEPA. The Blue Creek Project was not selected.

In 1979, the Watershed Steering Committee submitted an application to the Agriculture Stabilization and Conservation Service (USDA-ASCS) to designate the Blue Creek Watershed as a Special Water Quality Project. It was designated on May 15, 1979.

Agricultural Stabilization and Conservation Service's Involvement

The Pike County ASCS Committee met May 1, 1979 with the county SCS representatives, County Extension Advisor, Members of the Soil and Water Conservation District Board, Members of the Blue Creek Steering Committee and two members of the SCS Watershed Planning Staff and one engineer and one economist from the SCS office from Lincoln, Nebraska. The purpose of this meeting was to discuss priority of practices and critical areas within the Blue Creek Watersheds. Control of feedlot run-off was stressed along with the need for livestock watering for confinement areas.

Mr. Keith Elledge, Chairman of the Blue Creek Steering Committee, along with Agency representatives (ASCS & SCS) presented an informational meeting to which all land owners/operators in the Blue Creek Watershed areas were invited. Each Agency representative explained the requirements for meeting cost-sharing eligibility and the priority of acceptable practices.

Following this meeting the ASCS County Committee prepared a Special Water Quality Practice Application requesting cost-sharing for waterlines to newly constructed confinement feeding areas for livestock. This request was submitted to the State ASCS Office on May 8, 1979 and approval was received May 15, 1979. Two other special practices were requested and approval was received for each. One practice for stream protection provides cost-sharing for permanent fencing to protect banks from damage by domestic livestock; planting trees, shrubs or perennial grass cover as filter strips or buffer zones along banks; to provide access to water for livestock and to install livestock crossings that will retard sedimentation and related pollution. The second practice was for fencing as part of the Establishment of Permanent Vegetation Practice. A list of conservation practices eligible for share is listed in Table 14.

Regular contact with land owners/operators by representatives of ASCS has kept land owners/operators informed of practice eligibility and assistance. As of October 1, 1980 six long-term agreements have been approved with cost-sharing amounting to $129,936. Annual approvals amount to $73,024.

TABLE 14

List of conservation practices *(Regular and Long Term Agreements (LTA)) eligible for cost-share in the Blue Creek Watershed as part of the ASCS - Special Water Quality Project.

PRACTICE NAME	PRACTICE NUMBER
Permanent Vegetative Cover Establishment	SL-1
Permanent Vegetative Cover Improvement	SL-2
Stripcropping Systems	SL-3
Terrace Systems	SL-4
Diversions	SL-5
Grazing Land Protection	SL-6
Windbreak Restoration or Establishment	SL-7
Cropland Protective Cover	SL-8
Permanent Vegetative Cover on Critical Area	SL-11
Contour Farming	SL-13
Minimum Tillage	SL-14
No-Till	SL-15
Water Impoundment Reservoir	WC-1
Sediment Retention or Water Control Structure	WP-1
Stream Protection	WP-2
Sod Waterways	WP-3
Animal Waste Control Facilities	WP-4
Forest Tree Plantations	FR-1
Forest Tree Stand Improvement	FR-2
Permanent Wildlife Habitat	WL-1
Shallow Water Area for Wild Water Fowl	WL-2

*A detailed description of these practices is available from the ASCS.

Soil Conservation Service's Involvement

The Soil Conservation Service (SCS) has had a major part in the overall Blue Creek Special Project from its beginning in 1979. SCS has worked cooperatively with various government agencies and the Blue Creek Steering Committee in treating the watershed to control off-site damages and improve water quality.

Resource Management Systems are being developed by the SCS to meet the goals of the project and concerns of the people. The Blue Creek Special Water Quality Project is an ASCS cost-share program that assists farmers in installing conservation practices to protect the resource base. SCS is working to bring the entire watershed resource base under protection. Cropland, woodland, and all other lands are areas of concern. The SCS is working to control erosion and also with livestock producers to control problems from waste runoff and erosion associated with livestock operations.

The eligible cost share practices in the watershed are listed in Table 14. The SCS has the technical responsibility to determine the needs for different practices, the design, and supervision of installation of the practices.

The SCS and the other agencies involved have been in contact with the landowners and operators to encourage systems that will protect the resource base and enhance water quality. As of October 1, 1980; 20% of the cropland has had resource management systems implemented. A summary of conservation practices installed in the Blue Creek Watershed as of October 1, 1980 is listed in Table 15.

TABLE 15

Summary of conservation practices implemented in the Blue Creek Watershed as of October 1, 1980.

CONSERVATION PRACTICE	DATE OF INSTALLATION	LOCATIONS: SECTION & TOWNSHIP	ACRES TREATED
lagoon	2/80	29 Griggsville	2
terrace	11/79	3 Newburg	10
waterway	7/80	32 G'ville	15
no till	6/80	29 G'ville	17
no till	6/80	7 Newburg	21
strip cropping	6/80	32 G'ville	43
pond	9/80	17 Newburg	1
structure	9/80	33 G'ville	17
vegetative filter strip	8/80	34 G'ville	2
no till	6/80	34 G'ville	8
no till	6/80	17 Newburg	40
contouring	6/80	17 Newburg	6
no till	6/80	7 Newburg	15
no till	6/80	32 G'ville	24
conservation tillage	6/80	32 G'ville	31
structures (11)	9/80	5 Newburg	10
critical area seeding and pasture improvement	6/80	5 Newburg	32
structure	9/79	5 Newburg	27
terrace	9/79	5 Newburg	50
structures (8)	9/79	8 Newburg	8
terraces (2)	5/80	5 Newburg	33
terrace	9/79	5 Newburg	18
vegetative strip	9/80	5 Newburg	2
waterway	9/80	5 Newburg	26
permanent vegetative cover	6/80	29 & 30 G'ville	12
critical area seeding	6/80	29 & 30 G'ville	3
terrace	9/80	29 & 30 G'ville	3
waterway	9/80	29 & 30 G'ville	36
contouring	9/79	29 & 30 G'ville	38
contouring	9/79	30 G'ville	20
contouring	8/79	34 G'ville	40
no till	6/79	32 G'ville	30
no till	6/79	33 G'ville	37
contouring	8/79	5 Newburg	35
no till	8/79	5 Newburg	7
contouring	8/79	33 G'ville	70

TABLE 15

(Continued)

CONSERVATION PRACTICE	DATE OF INSTALLATION	LOCATIONS: SECTION & TOWNSHIP	ACRES TREATED
waterway	9/79	8 Newburg	1
no till	6/79	8 Newburg	21
waterway	9/80	33 G'ville	2
no till	6/79	10 Newburg	19
terrace	9/79	32 G'ville	11
no till	6/79	17 Newburg	14
terrace	9/79	31 G'ville	1
contouring	5/79	33 G'ville	21
terrace	9/79	3 Newburg	2
contouring	6/79	29 G'ville	20
structures (2)	9/79	3 Newburg	2
no till	6/79	7 Newburg	15

BACKGROUND STUDIES AND RESULTS

The following section delineates project elements that are being continued or have been completed, these elements are supplemental to the tributary monitoring. Each abstract briefly describe the project and their results if available, for further information obtain the cited reference or contact the author. A report pertaining to the baseline water quality conditions in the watershed will be available in 1982.

Intermittent Stream Investigation (IEPA, 1981)

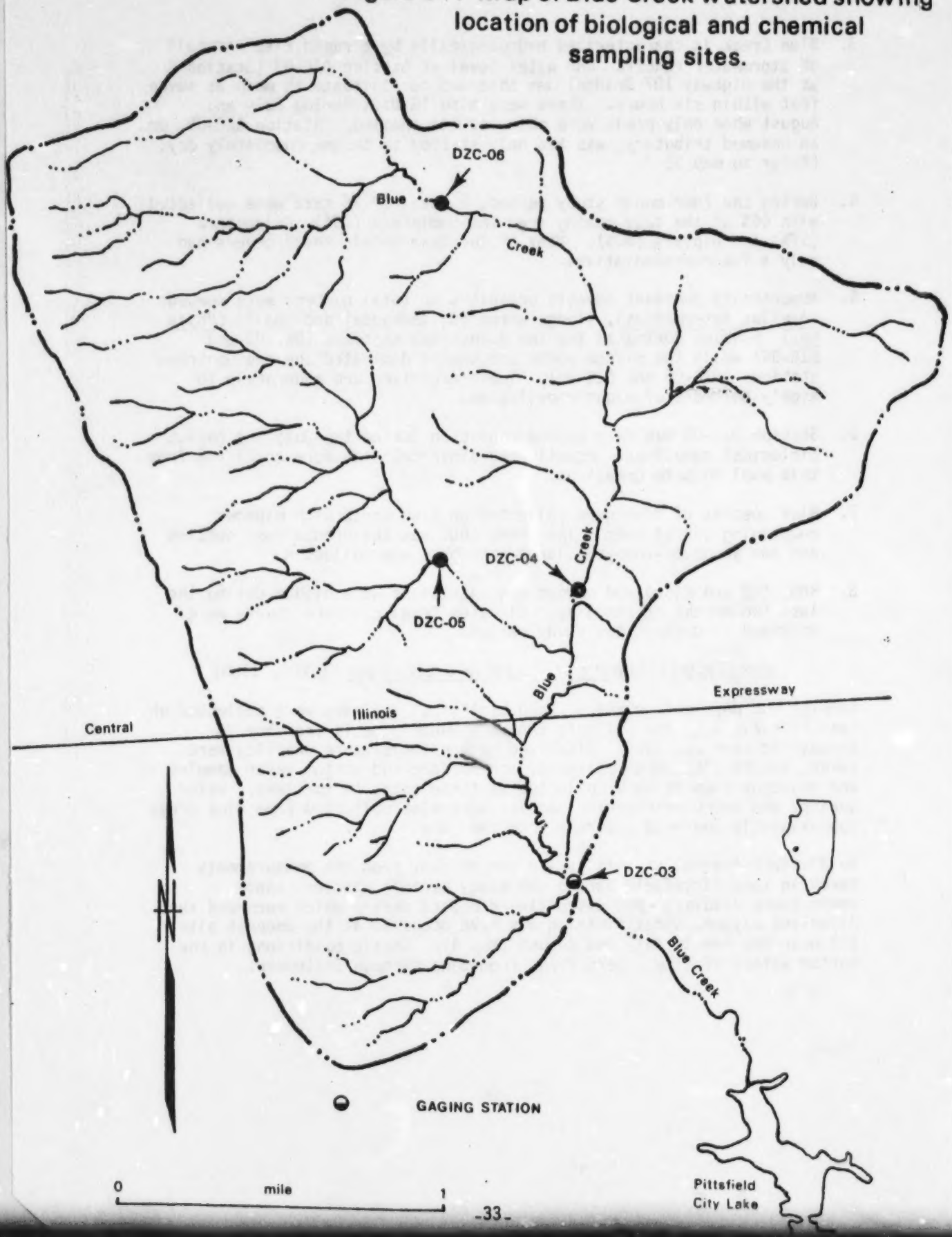
This survey is one of several conducted on intermittent streams in Illinois during summer, 1980. Basic objectives of these surveys were to characterize the physical, biological and chemical attributes of streams with intermittent flow to enhance the knowledge of the State's surface waters.

In Illinois, an estimated 85% of total stream miles is comprised of first, second and third order streams. Many of these are intermittent streams -- that is, they at times have a surface flow, or discharge rate, of zero. These intermittent streams pose special management problems because: (1) a large percentage of wastewater treatment facilities in the State (around 85%) discharge to these streams and a proportionately large share of pollution abatement resources are expended on these facilities; and (2) the complex ecological relationships of the State's intermittent streams are not well understood. Because many of these small headwater streams do not support significant commercial or recreational activities such as fishing or swimming, these waters are often considered economically unimportant and thus have not been the focus of intensive research efforts. The broad application of uniform water quality standards is probably no longer appropriate for Illinois waters of widely differing quantity, quality, and potential use. Ultimately, to provide adequate levels of protection for waters of the State, a better understanding of the hydrological and ecological dynamics of intermittent streams and their intra-watershed relationships is necessary.

1. Blue Creek and an unnamed tributary were sampled biologically and chemically on a routine monthly basis at four (two first order stream sites and two second order) stations from June 12 through September 17, 1980.

2. Blue Creek, which has a sand bottom with varying amounts of gravel and sediment, has no known municipal or industrial source discharges to the stream, but there are approximately 460 acres of hog and cattle feedlots on 21 farms within the basin.

Figure 3 . Map of Blue Creek watershed showing location of biological and chemical sampling sites.



3. Blue Creek is characterized hydrologically by a rapid rise and fall of stormwater runoff. The water level at Station DZC-03 (Station C at the Highway 107 Bridge) was observed to fluctuate as much as seven feet within six hours. There were also 18 days during July and August when only pools were observed and sampled. Station DZC-05, on an unnamed tributary, was the only station to become completely dry. (Refer to map 3)

4. During the four month study period, a total of 76 taxa were collected with 66% of the taxa coming from the Hemiptera (19%), Coleoptera (17%) and Diptera (30%). Many of the taxa within these orders had only a few representatives.

5. Numerically dominant aquatic organisms in total numbers were sowbugs (Asellus intermedius), sludge worms (Oligochaeta) and snails (Physa sp.) Sowbugs dominated the two downstream stations (DZC-03 and DZC-04) while the sludge worms and snails dominated the two upstream stations (DZC-05 and DZC-06). These organisms are moderately to highly tolerant of organic pollution.

6. Station DZC-05 was in a pooled condition during the July and August biological samplings. Aquatic macroinvertebrates were collected from this pool on both occasions.

7. Nine species of fish were collected on Blue Creek with minnows comprising six of them. The creek chub was the predominant species and one young-of-the-year largemouth bass was collected.

8. BOD, COD and dissolved oxygen concentrations were higher during the last two months of sampling. Elevated fecal coliform counts were observed throughout the study period.

Limnological Summary of Pittsfield City Lake (IEPA, 1980)

Samples for physical, chemical, and biological analyses were collected on Lake Pittsfield by the Illinois EPA on a monthly basis from May 23 through October 29, 1979. Dissolved oxygen/temperature profiles were taken, Secchi disc depth measured, and surface and bottom water samples and sediment samples were collected at three sites in the lake. Water quality and macroinvertebrate samples were also collected from Blue Creek approximately one mile upstream from the lake.

No distinct thermal stratification was evident from the measurements taken in Lake Pittsfield during the study period; however, since temperature readings were discontinued beyond depths which recorded zero dissolved oxygen, stratification may have occurred at the deepest site (1) near the dam in July and August (Map 4). Anoxic conditions in the bottom waters of site 1 were found from June through September.

The waters of Pittsfield City Lake are turbid. Secchi disc visibility ranged from six inches in May to 40 inches in June and averaged 19 inches. Suspended particulate concentrations were high. Mean values for total and volatile suspended matter, and turbidity in the surface waters were 26.4 mg/l, 5.5 mg/l, and, 22 NTU, respectively, while bottom water concentrations were much higher. On the average, volatile suspended solids comprised 21% of the total suspended solids, indicating that most of the turbidity was due to suspended inorganic material. A definite "uplake-downlake" difference in water quality was noted within the lake. Site 3, at the headwaters, had much higher values for suspended particulate matter and lower Secchi disc depths than the sites further downlake.

Nutrient levels in Lake Pittsfield are high. Total phosphorus concentrations ranged from 0.05 to 0.70 mg/l, exceeding the Illinois Pollution Control Board (IPCB) general use standard of 0.05 mg/l in all but one sample. On the average, one-fourth of the total phosphorus was comprised of dissolved forms. Nitrate-nitrite nitrogen concentrations in Lake Pittsfield exceeded 1.0 mg/l in May and June; they were 0.29 mg/l or less during the remainder of the study. Ammonia concentrations ranged from 0.01 to 2.0 mg/l, with Site 1 bottom water samples having the highest concentrations (* = 0.88 mg/l).

Maximum phytoplankton densities (1420/ml) for Pittsfield City Lake occurred in May, lowest densities (103/ml) were recorded during the June 11 sampling, and densities increased again from July through September.

In May, September, and October, the phytoplankton population was chiefly diatoms, while in July and August, green and blue-green algae were dominant, respectively. The mean chlorophyll a concentration for Pittsfield City Lake during this study was 23 ug/l, with values ranging from less than 1 to 86 ug/l. The maximum chlorophyll a concentration occurred in July. Highest phytoplankton density and chlorophyll a concentrations consistently occurred at Site 3 in the lake headwaters.

Fecal coliform counts for Pittsfield City Lake ranged from 2/100 ml to 1110/100 ml. Fifty percent of the determinations at site 3 were above the IPCB general use standard. Fecal coliform counts were occasionally high (1,110/100 ml) not only at Site 3 in the lake headwaters, but also in Blue Creek (2390/100 ml).

Concentrations of heavy metals and persistent organics in water samples from Lake Pittsfield were generally either below detectable limits or well below state standards. Exceptions were total copper, total iron, and total manganese, which had maximum concentrations of 70 ug/l, 2900 ug/l, and 2800 ug/l, respectively, exceeding IPCB standards in 17, 36.7 and 10 percent of the water samples, respectively.

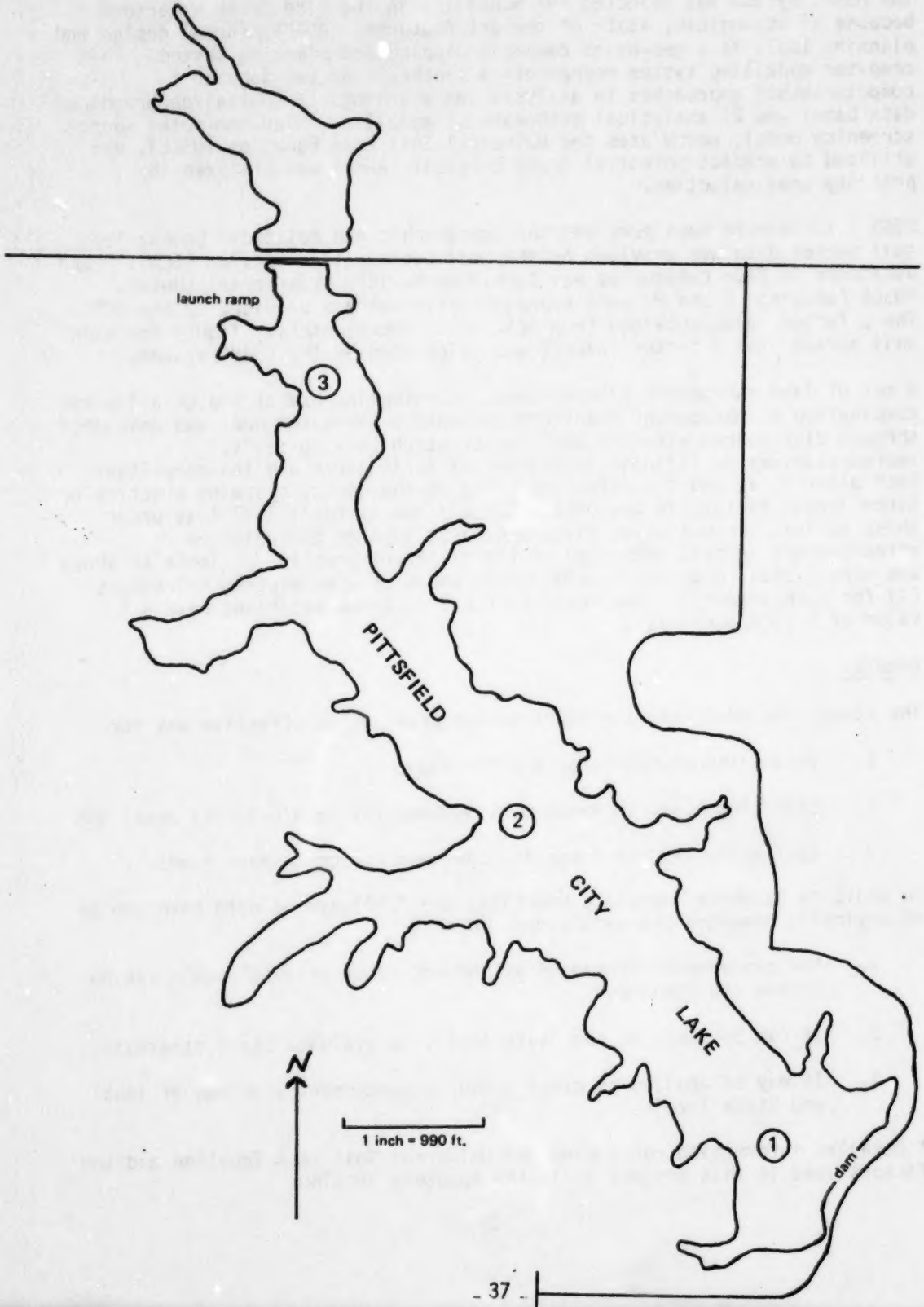
Sediment analysis indicated (as is true in most Illinois impoundments) that there was a strong general trend for sediment parameter values to increase from the headwaters (site 3) to the dam (site 1). Percent volatile solids, total Kjeldahl nitrogen and total phosphorus were either low or moderate in concentration (4.8 percent, 1877 mg/kg and 557 mg/kg, respectively) with silt and clay dominating in content. Iron and manganese were the only heavy metals found in high amounts with an average of 31,000 and 1,120 mg/kg, respectively. Other heavy metal concentrations showed a moderate concentration as compared to USEPA guidelines. Persistent organics in lake sediments that show moderate levels in concentration were dieldrin, chlordane and heptachlor epoxide with means of 3.3, 12, and 2.1 ug/kg, respectively.

Macroinvertebrate Sampling of Pittsfield City Lake

Macroinvertebrate samples were collected from the littoral zone at three sites in Pittsfield City Lake on July 16, 1980. The same qualitative methods were used at these sites as are used in routine stream sampling. Littoral sampling sites were selected on the basis of their proximity to the water quality sampling sites and their diversity of habitat. All of the macroinvertebrate sampling sites were the same as those sampled during the 1979 lake study.

Examination of the data indicates that most of the macroinvertebrates collected in 1980 (Appendix 4B) consisted of climbers, sprawlers, bottom and surface dwellers. A few swimmers were also collected. These organisms are commonly found in quiet waters such as lakes or pools in a stream. When compared with the July 18, 1979 sampling data (Appendix 4A), macroinvertebrate populations in Pittsfield City Lake have declined in both total numbers and in taxa. The populations, however, have remained relatively constant with the October 1, 1979 sampling data.

Fig. 4 Map of Pittsfield City Lake (RD-BO6-P) showing location of three sampling sites.



Land Cover/Water Quality Relationships Project (Gates, 1981)

The ADAPT system was selected for modelling in the Blue Creek watershed because of its unique, state of the art features. ADAPT, (areal design and planning tool) is a geo-based computer mapping and planning system. This computer modelling system represents a synthesis of two popular computer-based approaches to analysis and planning, 1) spatial/geographical data base; and 2) analytical mathematical modelling. The non-point source screening model, which uses the Universal Soil Loss Equation (USLE), was utilized to predict potential gross erosion. ADAPT was utilized in priority area selection.

USGS 7 1/2 minute maps provided the topographic and political boundaries; soil series data was provided by the Soil Conservation Service (SCS). Land use/cover in five categories was furnished by IEPA from aerial photos. *USLE factors: C and P, were representative numbers provided by the SCS. The L factor, also obtained from SCS, was a representative figure for each soil series, the S factor (slope) was calculated by the ADAPT system.

A set of land management alternatives, representing use of one or a limited combination of management practices throughout the watershed, was developed through discussions with the Soil Conservation Service staff, representatives of Illinois Department of Agriculture and the consultant. Each alternative had the effect of changing the cover, cropping practice or slope length factors in the USLE. Calculation of total soil loss under these various circumstances gives a general idea of the relative effectiveness in this watershed of the different practices. Table 16 shows the acres, total erosion, erosion/acre, and % of area meeting tolerances (T) for each scenario. The soils in the Blue Creek watershed have a T value of 5 tons/acre/year.

Results

The study concluded that the ADAPT system provides an effective way for:

1. establishing project area priorities;
2. selecting Resource Management Systems for each priority area; and
3. estimating program costs and the need for cost-share funds.

In addition to these immediate benefits, the ADAPT system data base can be economically expanded and maintained, so that:

1. New management strategies at the watershed or local scale can be tested and compared.
2. It can be used, at the State level, to evaluate State strategies.
3. It may be applied to other resource management problems at local and State levels.

* Detailed information concerning the Universal Soil Loss Equation and the factors used in this project is in the Appendix Section.

TABLE 16

Summary of ten selected management alternatives in the Blue Creek Watershed.

SCENARIO #	ALTERNATIVE	GROSS EROSION (TONS/YR)	AVERAGE EROSION RATE (TONS/AC/YR)	PAT OF ACRES MEETING "T"
1	Conventional Tillage Residue Left Fall Up & Down Plowing	187,000	26.7	22.8
2	Conventional Tillage Contour Plowing Fall Plow	129,000	18.5	29.2
3	Spring Plowing Conventional Tillage	172,000	24.5	23.3
4	Conservation Tillage 1,500 lb. Residue	76,000	10.9	37.4
5	Conservation Tillage 3,500 lb. Residue	47,000	6.8	57.7
6	Conservation Tillage 6,000 lb. Residue	35,000	5.0	70.0
7	Terracing 90 Feet	103,000	14.8	36.3
8	Terracing 120 Feet	117,000	16.7	32.8
9	Terracing 150 Feet	129,000	18.4	30.6
10	Conservation to Pasture On Greater Than 15% Slope Land	152,000	21.6	25.8

Gross Erosion Assessment in the Blue Creek Watershed Pike County, Illinois

by

Ming T. Lee (1981)
Illinois State Water Survey

Gross erosion assessment is a part of the erosion-sedimentation study in the Blue Creek Watershed. The field data inventory was performed by Wayne Kinney, Steve Chick, and Edward Johnston of the Soil Conservation Service. The objectives of the assessment are to: 1) inventory the present soil, land use, and conservation practice conditions in the field; 2) compute the present soil loss rates in the watershed based on the present conditions; and 3) compute soil loss rates based on a few selected management practices to simulate the change of soil loss rates.

In order to relate the gross erosion data to sedimentation data, a sub-watershed upstream of suspended sediment gaging station C, which is located at the Highway 107 bridge, was selected for detailed gross erosion study. There are 73 soil mapping units in the sub-watershed. The total drainage area is 3,268 acres. The Universal Soil Loss Equation was used to compute the soil loss rates.

Under the present conditions, the total amount of annual gross erosion is 41,096 tons. This is equivalent to an average annual soil loss rate of 12.6 tons per acre per year. The average soil loss rates in the soil mapping units show high standard deviations which mostly are due to different land use categories.

The soil loss rates were also sorted based on nine land use categories. Cropland is the dominant land use which covers about 58 percent of the watershed. The soil loss rate of the cropland is 18.1 tons which is the highest among all the land use categories. The second dominant land use is pasture which covers about 20 percent. The average soil loss rate from pasture is 4.4 tons per acre per year which is below the soil loss tolerance rate. The farmstead, residential, and hayland areas have relative small acreages. Their soil loss rates range from 0.2 to 5.5 tons per acre per year. The wildlife and woodland categories cover 7 percent (238 acres) and 6 percent (186 acres) which have soil loss rates of 2.9 and 4.9 tons per acre per year, respectively. The other land uses consist of ideal, natural areas and small tract areas which were not defined in the inventory. This covers about 6 percent (188 acres) which has a soil loss rate of 11.9 tons per acre per year.

In order to simulate changes of soil loss rates due to the management practices, nine scenarios were selected. They are: 1) spring plow; 2) contour plowing; 3) conservation tillage with 1,500 pounds of residues; 4) conservation tillage with 3,500 pounds of residues; 5) conservation tillage with 6,000 pounds of residues; 6) terracing with 90 foot spacings; 7) terracing with 120 foot spacings; 8) terracing with 150 foot spacings; and 9) converting to pasture for 15 percent greater land slope.

If contour plowing is applied to the cropland, the total amount of gross erosion could be reduced to 68 percent of the present level and 57.2 percent of the watershed could meet the tolerance value (T value).

If spring plowing was applied to the watershed, the gross erosion could be reduced by 96 percent of the present level. This also indicated that 46.8 percent of the watershed will meet the T value.

If conservation tillages with 1,500, 3,500 and 6,000 pounds of residues were applied, the net effort will reduce the total amount of soil by 50, 34 and 26 percent of the present levels, respectively. The results also indicated that 60, 73 and 82 percent of the land will meet T value.

If terracing with 90, 120 and 150 foot spacings were applied to the watershed, the amount of soil loss could be reduced by 58, 62 and 65 percent of the present level and 63, 60 and 59 percent of the land would meet the T value.

If the conversion to pasture on 15 percent or greater land slope was implemented in the watershed, the gross erosion will be reduced by 16 percent of the present level and 48.4 percent of the land will meet the T value.

The amount of gross erosion and past reservoir sediment surveys were used to derive a sediment delivery ratio. The result indicated that about 48 percent of the sediment was delivered to the lake.

Stream Geometry and Channel Characteristics

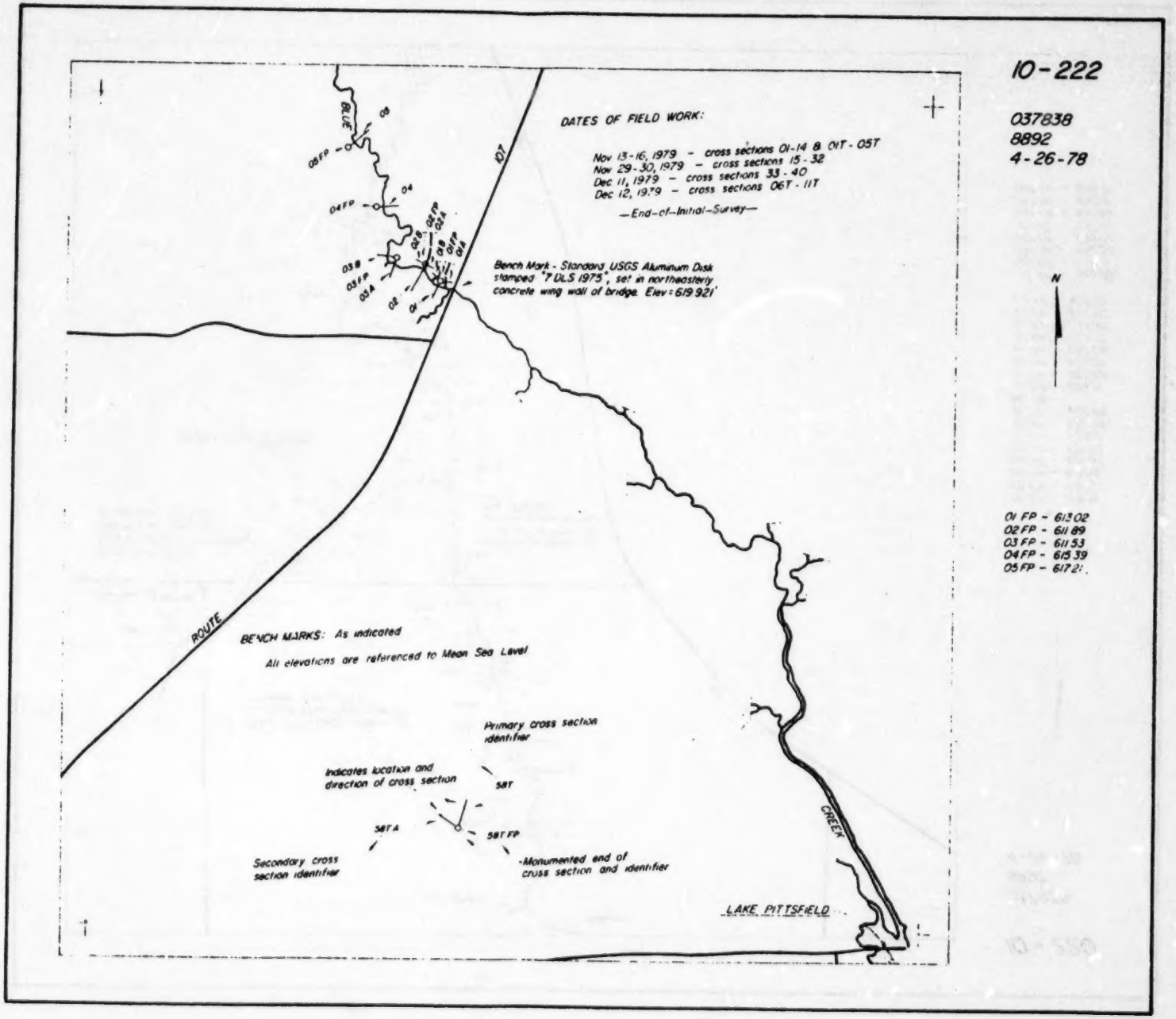
The stream geometry and channel characteristics element consist of two parts: 1) monitoring channel dynamics; and 2) analyzing particle size distributuion of bed material at certain stream location after rainfall events. The cross section were measured in 1979 and 1980 to show changes in the stream cross section due to deposition and scouring. The monitoring of channel dynamics consisted of determining cross sectional area of the channel at 51 locations, 40 on Blue Creek and 11 on a tributary to Blue Creek (refer to maps 5 through 9). Comparisons of the 1979 and 1980 cross sectional area are not complete at this time, a report will be published when this work element is completed.

Determining deposition and scouring in the channel at 51 locations combined with the particle size distribution analyses of bed material at five sites in the channel will enable the contribution of bed material to the total suspended load to be estimated. Bed particle size was sampled six times during the 1979-80 water year. Table 17 presents the average bed particle size distribution by site for sand, silt and clay. A report will be published when this work element is completed.

TABLE 17

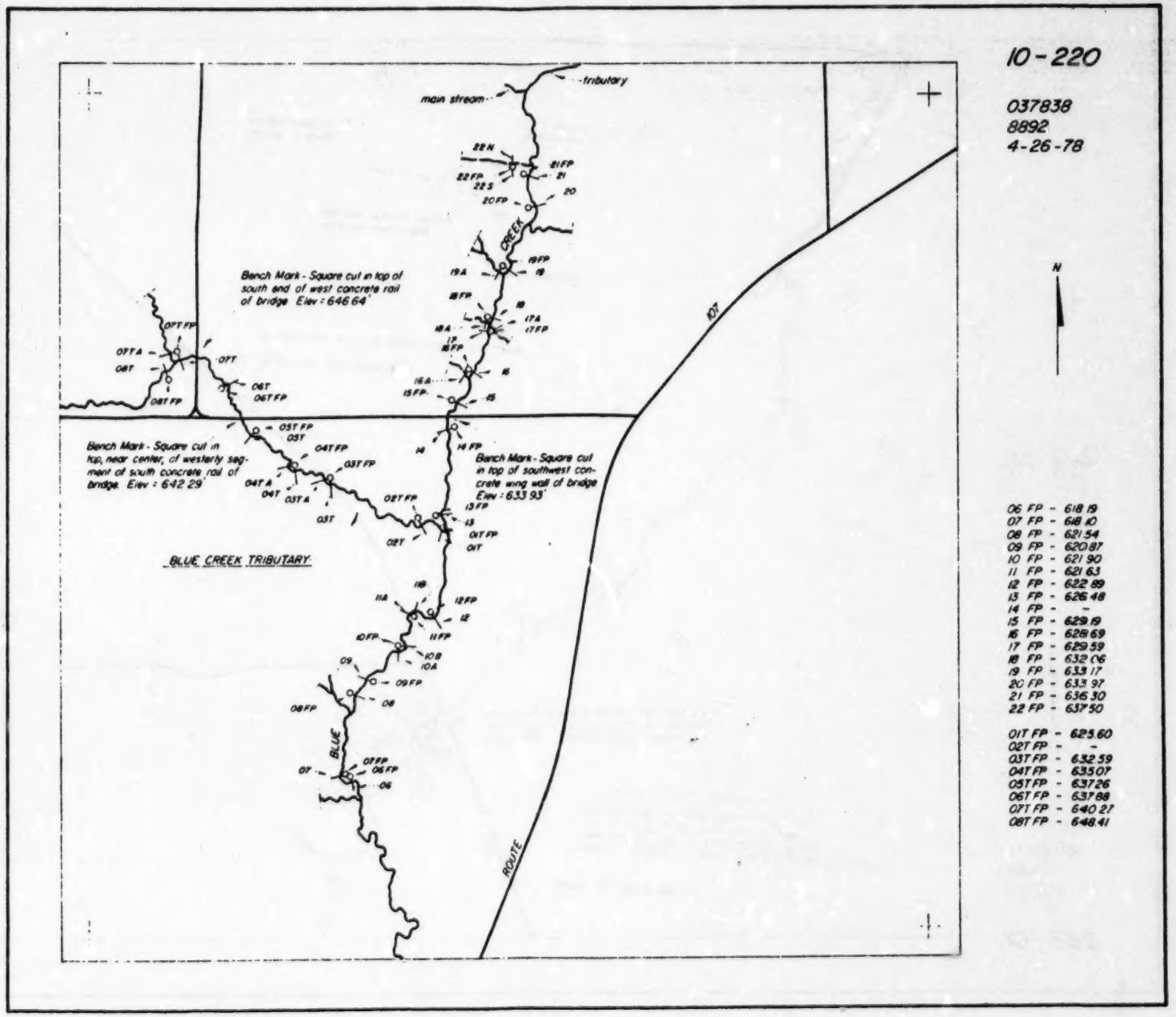
Average bed particle size distribution of sand, silt and clay by sampling location for April 02 & 11; May 16, 20 & 27; and June 13, 1980.

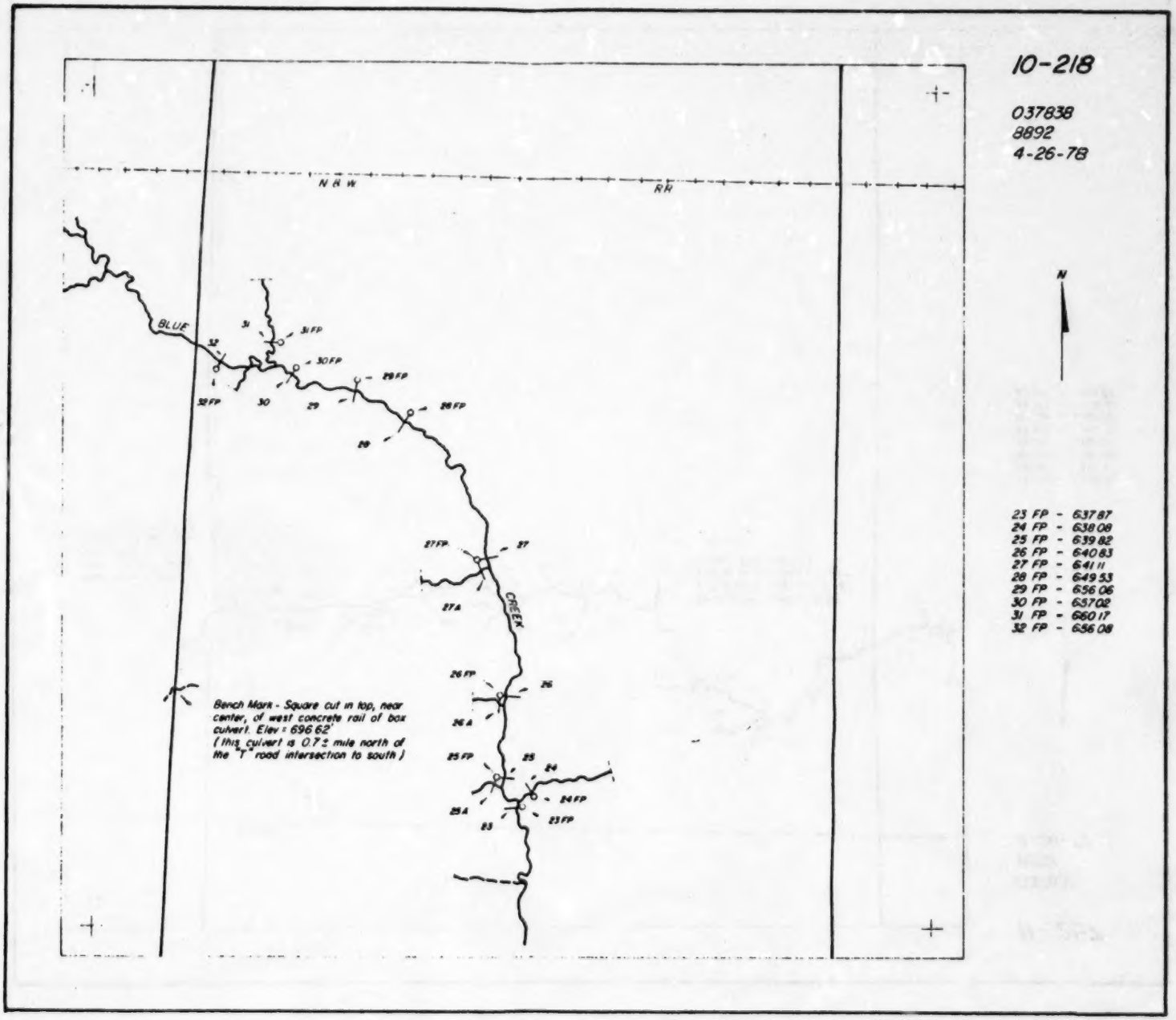
	PERCENT FINER BY WEIGHT			
SAMPLE LOCATION	GRAVEL %	SAND %	SILT %	CLAY %
32FP	6	20	47	27
23FP	11	47	29	13
15FP	9	41	37	13
08TFP	44	40	12	4
05FP	4	80	11	5

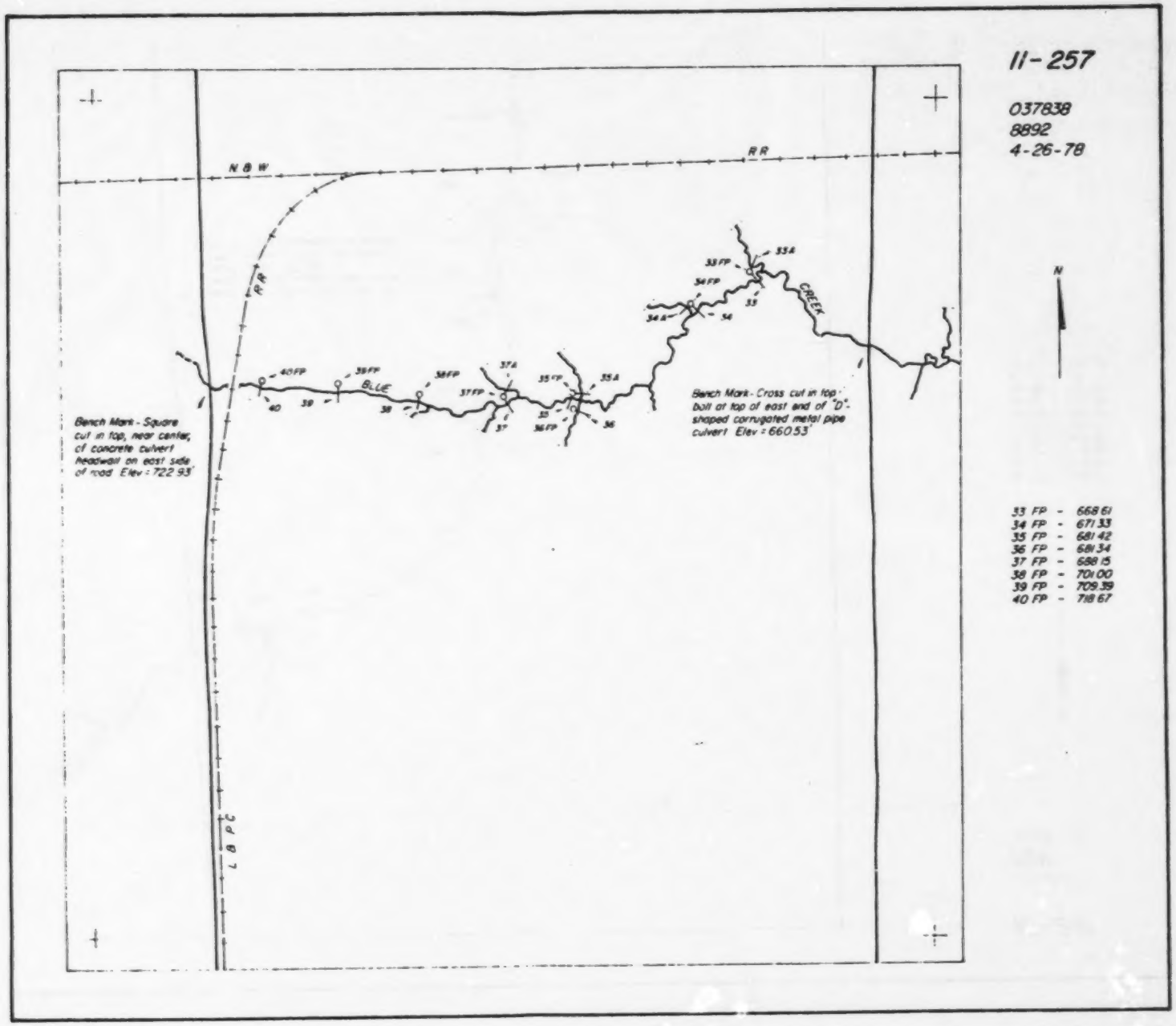

DATES OF FIELD WORK:
Nov 13-16, 1979 - cross sections 01-14 & 01T - 05T
Nov 29-30, 1979 - cross sections 15 - 32
Dec 11, 1979 - cross sections 33 - 40
Dec 12, 1979 - cross sections 06T - 11T
—End-of-Initial-Survey—
Bench Mark - Standard USGS Aluminum Disk stamped "7 U.S. 1975", set in northeasterly concrete wing wall of bridge. Elev = 619.921'
N
01 FP - 613.02
02 FP - 611.89
03 FP - 611.53
04 FP - 615.39
05 FP - 617.21
BENCH MARKS: As indicated
All elevations are referenced to Mean Sea Level
Primary cross section identifier
Indicates location and direction of cross section
Secondary cross section identifier
-Monumented end of cross section and identifier
ROUTE
CREEK
LAKE PITTSFIELD

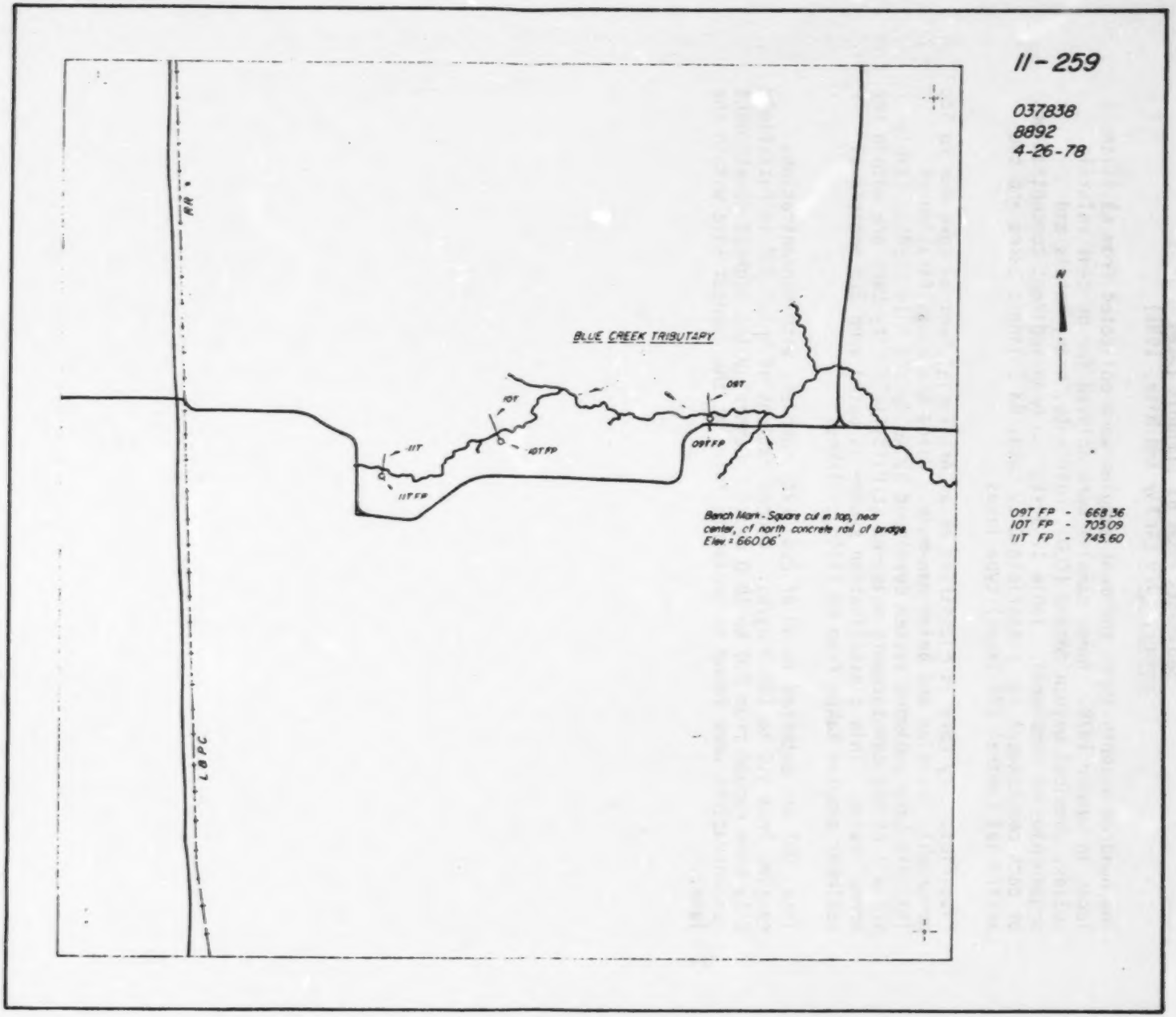
10-222

037838
8892
4-26-78


10-220
037838
8892
4-26-78
main stream
tributary
CREEK
BLUE CREEK TRIBUTARY
Bench Mark - Square cut in top of south end of west concrete rail of bridge Elev : 646.64'
Bench Mark - Square cut in top, near center, of westerly segment of south concrete rail of bridge. Elev : 642.29'
Bench Mark - Square cut in top of southwest concrete wing wall of bridge Elev : 633.93'
BLUE
ROUTE
107
N
06 FP - 618.19
07 FP - 618.10
08 FP - 621.54
09 FP - 620.87
10 FP - 621.90
11 FP - 621.63
12 FP - 622.89
13 FP - 626.48
14 FP -
15 FP - 629.19
16 FP - 628.69
17 FP - 629.59
18 FP - 632.06
19 FP - 633.17
20 FP - 633.97
21 FP - 636.30
22 FP - 637.50
01T FP - 625.60
02T FP -
03T FP - 632.59
04T FP - 635.07
05T FP - 637.26
06T FP - 637.88
07T FP - 640.27
08T FP - 648.41


10-218
037838
8892
4-26-78
N
N & W
RR
BLUE
CREEK
31
31 FP
32
30 FP
29 FP
32 FP
30
29
28 FP
28
27 FP
27
27A
26 FP
26
26A
25 FP
25
24
24 FP
25A
23
23 FP
Bench Mark - Square cut in top, near center, of west concrete rail of box culvert. Elev = 696.62'
(this culvert is 0.7 ± mile north of the "T" road intersection to south)
23 FP - 637.87
24 FP - 638.08
25 FP - 639.82
26 FP - 640.83
27 FP - 641.11
28 FP - 649.53
29 FP - 656.06
30 FP - 657.02
31 FP - 660.17
32 FP - 656.08


11-257
037838
8892
4-26-78
N
N & W
RR
RR
CREEK
BLUE
33 FP
33A
34 FP
34A
35
36
35 FP
35A
36 FP
37
37A
37 FP
38
38 FP
39
39 FP
40
40 FP
Bench Mark - Square cut in top, near center, of concrete culvert headwall on east side of road Elev = 722.93'
Bench Mark - Cross cut in top bolt at top of east end of "D" shaped corrugated metal pipe culvert Elev = 660.53'
33 FP - 668.61
34 FP - 671.33
35 FP - 681.42
36 FP - 681.34
37 FP - 688.15
38 FP - 701.00
39 FP - 709.39
40 FP - 718.67


11-259
037838
8892
4-26-78
N
BLUE CREEK TRIBUTARY
09T
10T
11T
10T FP
09T FP
11T FP
Bench Mark - Square cut in top, near center, of north concrete rail of bridge
Elev = 660.06'
09T FP - 668.36
10T FP - 705.09
11T FP - 745.60
RR
201

Chemical Analysis of Surficial Sediments From 63 Illinois Lakes Summer, 1979 (Kelly and Hite, 1981)

Two hundred seventy-three sediment samples were collected from 63 Illinois lakes in summer 1979. These samples were anlyzed for percent volatile solids, chemical oxygen demand (COD), nutrients, heavy metals and organochlorine compounds. Table 17 lists the mean sediment concentrations of each constituent for Pittsfield City Lake, 63 Illinois Lakes and the artificial central (24 lakes) type lakes.

Pittsfield City Lake is classified as an Artificial Central Lake due to its geographic location and being man-made. Using the classification of Illinois Lake sediment system developed by Kelly and Hite (1981), (Table 17) all of the constituents measured at Pittsfield City Lake are within the normal range. This classification system is based upon 273 individual sediment samples taken from 63 Illinois lakes.

Total DDT was detected in 50 of 266 (19%) samples, with concentrations ranging from 5.0 to 102.0 ug/kg. Concentrations of total DDT in Pittsfield City Lake ranged from 5.0 to 18.0 ug/kg. Generally the highest constituent concentrations were found in sediments taken at the deepest site within the lake.

TABLE 18

Mean sediment constituent concentrations for Pittsfield City Lake, 63 Illinois Lakes and Artificial Central (24 lakes) type lakes, samples collected in 1979.

MEAN SEDIMENT CONSTITUENT	PITTSFIELD CITY LAKE	63 ILLINOIS LAKES	ARTIFICIAL CENTRAL LAKES
Percent Volatile Solid	5.78	8.83	8.52
Total Kjeldahl Nitrogen (mg/kg)	2194	3358	3077
Total Phosphorus (mg/kg)	549	666	577
COD (mg/kg)	40364	83347	68709
N:P Ratio	3.65	5.53	5.56
Organic Carbon (mg/kg)	28904	44154	42604
C:N Ratio	12.3	14.3	*
Arsenic (mg/kg)	10.0	11.17	8.75
Cadmium (mg/kg)	1.0	<0.98	<1.05
Chromium (mg/kg)	27.4	22.5	25.8
Copper (mg/kg)	51.7	41.3	42.5
Iron (mg/kg)	34000	28631	31507
Lead (mg/kg)	30.9	<49.6	36.6
Manganese (mg/kg)	1092	1313	1092
Mercury (mg/kg)	.052	<0.09	.072
Zinc (mg/kg)	98.2	111.0	111.8
DDT (ug/kg)	8.2		
Dieldrin (ug/kg)	3.9	6.0	
Meptachlor epoxide (ug/kg)	1.12		

TABLE 19

CLASSIFICATION OF ILLINOIS LAKE SEDIMENTS: Groupings for each constituent shown are based upon 273 individual sediment samples collected from 63 lakes in summer 1979. Ranges of concentrations displayed and resultant groupings are based on one or two standard deviations from mean (Kelly and Hite, 1981).

CONSTITUENT	BELOW NORMAL	NORMAL	ELEVATED	HIGHLY ELEVATED
Volatile Solids (%)	<5	5-13	13-17	>17
Total Kjeldahl Nitrogen (mg/kg)	<1650	1650-5775	5775-7850	>7850
Total Phosphorus (mg/kg)	<225	225-1175	1175-1650	>1650
COD (mg/kg)	<32500	32500-162000	162000-226500	>226500
N:P Ratio	<2.2	2.2-9.7	9.7-13.5	>13.5
Organic Carbon[1] (mg/kg)	<26500	26500-65550	65550-85100	>85100
C:N Ratio[1]	<11	11-17	17-20	>20
Arsenic (mg/kg)		<27	27-41	>41
Cadmium (mg/kg)		<1.8	1.8-2.6	>2.6
Chromium (mg/kg)	<14	14-30	30-38	>38
Copper (mg/kg)		<100	100-150	>150
Iron (mg/kg)	<18000	18000-36000	36000-45000	>45000
Lead (mg/kg)	<15	15-100	100-150	>150
Manganese (mg/kg)		<3000	3000-3900	>3900
Mercury (mg/kg)		<0.25	0.25-0.40	>0.40
Zinc (mg/kg)	<50	50-175	175-250	>250

[1]Organic carbon values were calculated from % volatile solids data.

Sedimentation Survey of Pittsfield City Lake Pittsfield, Illinois (Bogner, 1979)

Sediment surveys were conducted on Pittsfield City Lake in 1974 and 1979. The 1974 survey was performed by the City's engineering consultants, Benton and Associates of Jacksonville, Illinois and the 1979 survey by the Illinois State Water Survey.

Sounding data from 16 cross sections were collected in the 1979 survey. Map 10 shows the locations of the lake cross sections.

In both the 1974 and 1979 surveys sounding data were collected at 25 or 50 foot intervals on each cross section to measure both the original (1961) and current (1974 or 1979) depths of water in the lake at the spillway elevation. All depth measurements were made with a 2-inch diameter aluminum pole marked in tenths of feet. The pole was first lowered till it touched the current lake bottom and a depth measurement was made. The pole was then pushed through the accumulated sediment until it hit the solid original lake bed where another depth measurement was made (Bogner, 1979).

The results of the 1974 and the 1979 surveys shows that the lake has lost 19.7% of its original capacity as a result of sedimentation between 1961 and 1979. The average unit weight of the deposited sediment was 47.6 pounds per cubic foot based on data collected in 1979. There was a significant decrease in the sedimentation rate from 1.24%/yr. in 1974 to 0.64%/yr in 1979. Bogner (1979) stated "this decrease may have resulted from a combination of several factors, such as a change in the trap efficiency of the lake, variations in stream peak flow, and improved soil conservation measures established in the watershed".

"A minor change in the trap efficiency of the lake would result from the diminishing lake volume. However, a more important change could be caused by the distribution of the zones of decreased lake volume. For example, the area above the road in the upstream portion of the lake (above Station B, Map 2) is likely to have had a significant influence on the trap efficiency of the lake right after the construction of the dam because of flow restriction by the road causeway. By 1974, this area has lost 95% of its capacity to accumulated sediment and its influence on the total trap efficiency of the lake was reduced to almost zero". (Bogner, 1979)

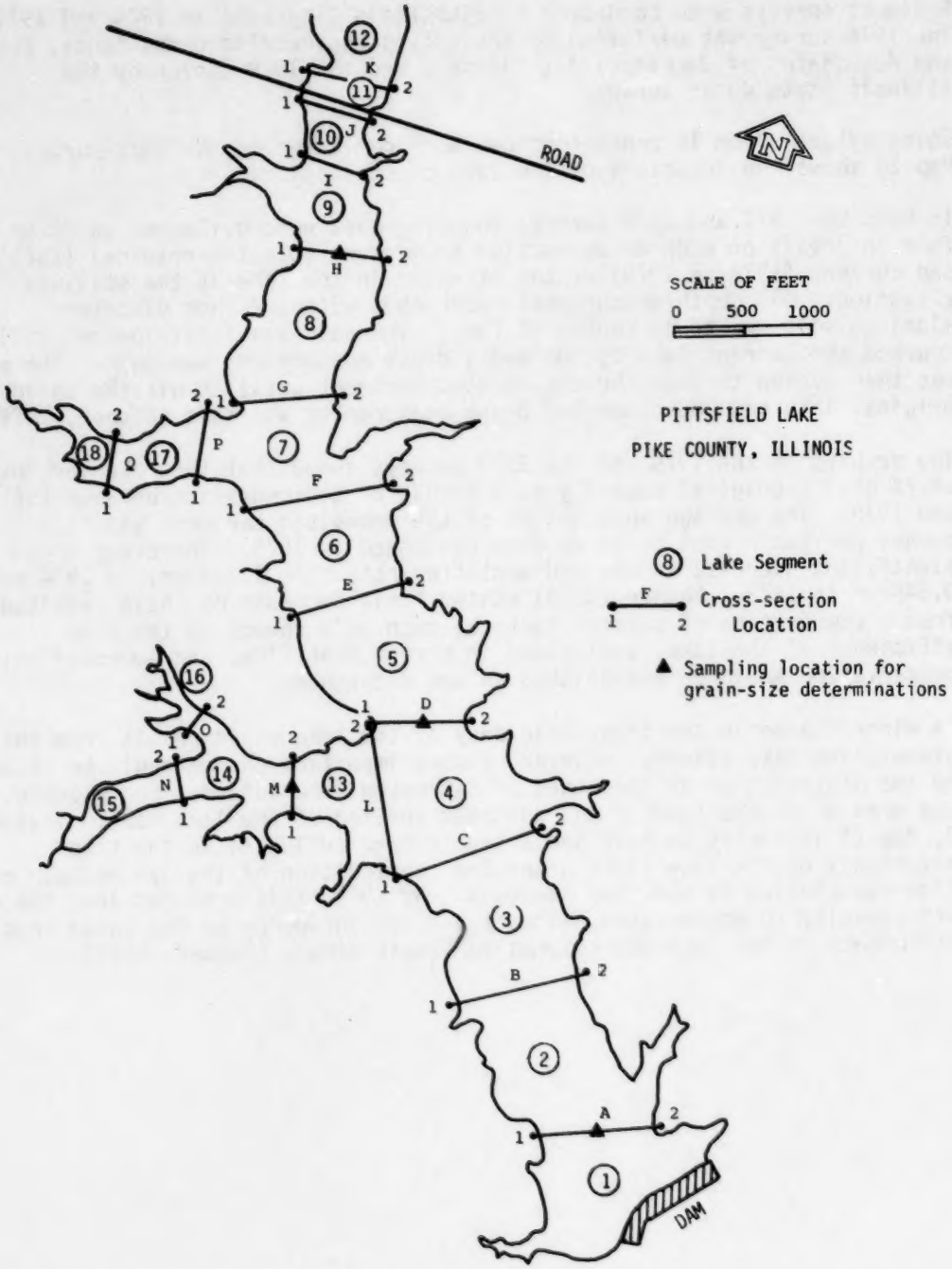


Figure 10. Locations of Range Stations and Segments for 1979 Sedimentation Survey

LITERATURE CITED

Bogner, W.D. 1979. Sedimentation Survey of Pittsfield Lake, Pittsfield, Illinois. Illinois State Water Survey, Urbana, Illinois. 20 pp.

Gates, W.E. & Associates, Inc. 1981. Data/Information Development for Assessing Impacts of Cropland Management Practices on Potential Annual Erosion, Final Report to Illinois Environmental Protection Agency. 26 pp.

Holton, H.N. Minshall, and L. Harold. 1968. Field Manual for Research in Agricultural Hydrology. USDA Agricultural Handbook. 214 pp.

Illinois Environmental Protection Agency. 1981. Investigation of Six Intermittent Streams, April - September 1980. Staff Report. Springfield, Illinois. 182 pp.

Illinois Environmental Protection Agency. 1980. Limnology of Pittsfield City Lake, Pike County, Illinois, May - October, 1979. Monitoring Unit; Division of Water Pollution Control; Illinois EPA; Springfield, Illinois. 87 pp.

Illinois Environmental Protection Agency. 1979. Water Quality Management Plan. Volume II Rural Clean Water Program Section. Springfield, Illinois.

Kelly, M.L. and R. L. Hite. 1981. Chemical Analysis of Surficial Sediments from 63 Illinois Lakes, Summer 1979. Monitoring Unit; Division of Water Pollution Control; Illinois Environmental Protection Agency; Marion, Illinois. 92 pp.

Lee, M.T. 1981. Gross Erosion Assessment in the Blue Creek Watershed, Pike County, Illinois. Illinois State Water Survey, Urbana, Illinois. (in press).

United States Department of Agriculture. 1977. Proposal - Model Implementation Project - Blue Creek Watershed, Pike County, Illinois. 25 pp.

United States Department of Agriculture, Soil Conservation Service and Illinois Agricultural Experiment Station. 1975. Soil Association of Pike County, Illinois. Pike County Soil and Water Conservation District; Pittsfield, Illinois. 8 pp.

United States Department of Commerce (Illinois). 1980. Climatological Data, Annual Summary 1979. National Oceanic and Atmospheric Administration, Environmental Data Service Asheville, North Carolina. 15 pp.

United States Department of Commerce. 1958. Rainfall Intensity - Duration - Frequency Curve. Weather Bureau, Technical Paper No. 25. U.S. Government Printing Office, Washington, D.C.

Walton, H. 1979. Illinois Environmental Protection Agency, Division of Water Pollution Control, Field Methods Manual. Sections A, B, D, E. Springfield, Illinois.

APPENDIX SECTION

APPENDIX 1

General Description of the Major Soils in the Blue Creek Watershed*

Clinton - Soils are gently sloping to strongly sloping and are moderately well drained. They occupy about 35% of the watershed. The less sloping Clinton soils are mainly on crests of narrow ridges and edges of medium width ridges. The more sloping Clinton soils are on sides of drainageways and stream valleys. The surface layer about 6 inches thick, is dark grayish brown loam. The subsurface is brown and dark brown silt loam about 6 inches thick. The subsoil is about 40 inches thick. It is yellowish brown silty clay loam and heavy silty clay loam mottled with gray in the lower part. The underlying material is yellowish brown silt loam mottled with gray. Clinton soils are moderately low in organic matter content and moderately slowly permeable. Clinton soils are suited to all crops commonly grown in the county if erosion is controlled.

Fayette -- Soils are gently sloping to steep and are well drained. They occupy about 31% of the watershed. Fayette soils are on valley sides and narrow to medium width ridges. The surface is dark grayish brown silt loam about 8 inches thick. The subsurface, about 5 inches thick, is brown silt loam. The subsoil is dark yellowish brown silty clay loam and is about 35 inches thick. Material underlying the subsoil is yellowish brown silt loam mottled with light yellowish brown. Fayette soils are moderate in organic matter content and permeability is moderate. Gently to strongly sloping Fayette soils are suited to all crops commonly grown in the county if erosion is controlled. Moderately steep and steep Fayette soils are suited to hay or pasture and woodland.

Rozetta -- Soils are nearly level to moderately sloping and are moderately well drained. They occupy about 7% of the watershed. Rozetta soils are on medium width ridges and valley sides. The surface layer is dark grayish brown silt loam, about 7 inches thick. The subsurface is brown silt loam about 5 inches thick. The subsoil, about 45 inches thick, is brown and yellowish brown silty clay loam. Underlying material is yellowish brown and light brownish gray silt loam. Rozetta soils are moderately low in organic matter content and moderately permeable. Rozetta soils are suited to crops commonly grown in the county if erosion is controlled.

* USDA-SCS, 1975

APPENDIX 2

Fish Species List for Pittsfield City Lake

Common Name	Scientific Name
Largemouth Bass	Micropterus salmoides
Bluegill	Lepomis macrochirus
Green sunfish	Lepomis cyanellus
Bluegill x green Sunfish hybrid	Lepomis sp.
White crappie	Pomoxis annularis
Black crappie	Pomoxis nigromaculatus
Walleye	Stizostedion vitreum vitreum
Sauger	Stizostedion canadense
Northern pike	Esox lucius
Carp	Cyprinus carpio
Channel catfish	Ictalurus punctatus
Black bullhead	Ictalurus melas
Yellow bullhead	Ictalurus natalis
Gizzard shad	Dorosoma cepedianum
Golden shiner	Notemigonus crysoleucas

APPENDIX 2 (CONT.)

Fall Population Census for Pittsfield City Lake, October, 1979

(electrofishing, gill net and hoop net)

Species	Number Collected	Size Range (in)	Weight Range (lbs)
Largemouth bass	45	3.0 - 18.5	0.02 - 4.22
Bluegill	87	2.0 - 6.5	0.03 - 0.16
Green sunfish	31	3.0 - 7.0	0.02 - 0.22
Bg x Gn sunfish	87	3.5 - 7.0	0.03 - 0.23
White crappie	192	6.0 - 12.5	0.08 - 1.06
Black crappie	6	7.5 - 8.5	0.18 - 0.27
Walleye	3	23.5 - 25.0	5.60 - 5.75
Sauger	1	16.5	1.75
Northern pike	2	27.5 - 30.5	4.54 - 6.00
Carp	78	10.0 - 24.0	0.49 - 8.50
Channel catfish	48	11.0 - 22.5	0.37 - 3.71
Black bullhead	4	6.0 - 9.5	0.11 - 0.46
Yellow bullhead	2	7.5 - 8.5	0.19 - 0.28
Gizzard shad	112	3.5 - 11.5	

Fish population census for Blue Creek,
Pike County, Illinois. July 2, 1980.
(IEPA, 1981)

Station	Species	Number Collected	Size Range (in)
DZC-03	Creek chub	55	1.3-5.4
	Suckermouth minnow	2	2.7-2.8
	Bigmouth shiner	19	1.8-2.7
	Red shiner	23	1.3-2.2
	Sand shiner	31	1.8-2.7
	Bluntnose minnow	15	1.6-2.9
	Black bullhead	3	2.4-2.6
DZC-04	Creek chub	23	2.4-5.2
	Red shiner	7	2.0-2.3
	Bluntnose minnow	1	2.4
	Black bullhead	1	3.7
DZC-05	Creek chub	24	1.6-4.5
	Suckermouth minnow	2	2.8
	Bigmouth shiner	10	2.0-2.5
	Red shiner	8	1.8
	Sand shiner	9	2.2-2.8
	Black bullhead	29	2.6-4.0
	Yellow bullhead	est. 12	est. 6.0-8.0
	Largemouth bass (YOY)	1	2.0

Species list of fish found in Blue Creek, Pike County.
July, 1980
(IEPA, 1981)

Common Name	Scientific Name	Food Preference
Creek chub	Semotilus astromaculatus	omnivore
Suckermouth minnow	Phenacobius mirabilis	insectivore
Bigmouth shiner	Notropis dorsalis	insectivore
Red shiner	Notropis lutrensis	insectivore
Sand shiner	Notropis stramineus	insectivore/detritivore
Bluntnose minnow	Pimephales notatus	omnivore
Black bullhead	Ictalurus melas	omnivore
Yellow bullhead	Ictalurus natalis	omnivore
Largemouth bass	Micropterus salmoides	carnivore

APPENDIX 3

Universal Soil Loss Equation (USLE)

The soil loss prediction formula* is as follows: A=RKLSCP where A is the average annual soil loss in tons per acre predicted by equation. This equation is applicable to cropland, pasture, woodland, wildlife land, and idle land.

R: The rainfall and runoff factor, is the number of rainfall erosion index units, plus a factor for runoff from snowmelt or applied water where such runoff is significant.

K: The soil erodibility factor is the soil loss rate per erosion index unit for a specified soil as a 72.6 ft. length of uniform 9% slope continously in clean-tilled fallow.

L: The slope-length factor, is the ratio of soil loss from the field slope length to that from a 72.6 ft. length under identical conditions.

S: The slope-steepness factor, is the ratio of soil loss from the field slope gradient under otherwise identical conditions.

C: The cover and management factor, is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled continuous fallow.

P: The support practice factor, is the ratio of soil loss with a support practice like stripcropping, or terracing to that with straight-row farming up and down the slope.

*See Wischmeier, W.H., and D.D. Smith, 1965. Universal Soil Loss Equation. Proc., Seventh Int. Cong. Soil Sci., Madison, Wisc., for development and use.

Scenaro #	Cropland C-Factor	P-Factor
1	.44	1.0
2	.44	SLOPE % / P 0-2 / 0.6 2-7 / 0.5 7-12 / 0.6 12-18 / 0.8 18-24 / 0.9 >24 / 1.0
3	.40	1.0
4	.31	0.5
5	.16	0.5
6	.10	0.5
7	.44	same as 2 slope length 90 feet
8	.44	same as 2 slope length 120 feet
9	.44	same as 2 slope length 150 feet
10	.44 for slopes <15%, .013 for slopes >15%	1.0
Pasture	.013	1.0
Woodland	0.08	1.0
Orchard	0.012	1.0

Slope Length - Representative Value by Soil Association

R - Factor 200

Average Annual Rain (inches 37)

APPENDIX 4A
QUALITATIVE MACROINVERTEBRATE SAMPLE DATA
From Littoral Areas in the Vicinity of Sites 1, 2, and 3
Pittsfield City Lake, Pike County, Illinois
July 18, 1979, and October 1, 1979

MACROINVERTEBRATE	Site 1		Site 2		Site 3	
	7-18-79	10-1-79	7-18-79	10-1-79	7-18-79	10-1-79
INTOLERANT						
Decapoda	5	1	4	1	4	
Hyalella azteca	4	1	22	4	37	
Gammarus sp.			6			
Callibaetis sp.			1			
Stenacron interpunctatum	6		4		1	
Stenonema scitulum	66	10				
Ischnura sp.			2			
MODERATE						
Dugesia sp.	97	23	12	1	2	
Asellus intermedius	14	1	6		1	
Amphiagroin sp.		1	7	14		4
Enallagma sp.				7	30	
Libellula sp.			3			3
Clinotanypus sp.			14	1	21	4
Polypedilum sp.		2			1	
Orthocladiinae		5			1	
Tanytarsus sp.	1	1	10	6	7	
FACULTATIVE						
Caenis sp.	1	2	68		35	2
Ranatra sp.					1	
Trichocorixa sp.			14	2	26	9
Mesovelia mulsanti			4		5	6
Gerris sp.						1
Trepobates sp.			7			5
Rheumatobates sp.			3			
Hydrometra sp.			2			
Microvelia			1			
Berosus sp.	5					
Cyphon sp.	3		18	2	5	2
Dubiraphia sp.				2		
Tropisternus sp.			4		6	1
Peltodytes sp.			1			

APPENDIX 4A
(Continued)

MACROINVERTEBRATE	Site 1		Site 2		Site 3	
	7-18-79	10-1-79	7-18-79	10-1-79	7-18-79	10-1-79
FACULTATIVE (Con't)						
Crenitis sp.			1		3	
Enochrus sp.			2			
Laccophilus sp.			2		6	3
Hydroporus sp.					8	
Hydrochus sp.					5	
Chrysops sp.					3	
Tabanus sp.						1
Palpomyia sp.	10			1	5	
Pentaneura mallochi	1		3			
Ferrisia sp.						1
Helisoma sp.			1			2
TOLERANT						
Oligochaeta	2	1	5	3	1	
Hirudinea			3		2	1
Stratiomys sp.					1	
Physa sp.			12	2	12	15

APPENDIX 4B
Lake Macroinvertebrate Data from Pittsfield City Lake, July 16, 1980.

	Site 1	Site 2	Site 3
INTOLERANT			
Stenonema tripunctatum scitulum	13		
Stenacron interpunctatum			1
Ischnura sp.		1	
MODERATE			
Amphiagrion sp.		2	1
Perithemis tenera		1	
Asellus intermedius	25	1	1
Dugesia sp.	24		
Clinotanypus sp.		1	1
Orthocladinae	1		
Tanytarsus sp.	4		2
FACULTATIVE			
Caenis sp.		7	2
Neoplea sp.			1
Rheumatobates sp.		10	
Sigara sp.			3
Tabanus sp.		1	
Scirtes sp.		2	
TOLERANT			
Chironomus sp.		1	
Oligochaeta		3	2

APPENDIX 5

ABBREVIATIONS and SYMBOLS

USDA	--	United States Department of Agriculture
ASCS	--	USDA, Agricultural Stabilization and Conservation Service
SCS	--	USDA, Soil Conservation Service
ICES	--	Illinois Cooperative Extension Service
RC&D	--	Resource Conservation and Development Area
DOC	--	Department of Conservation
IEPA	--	Illinois Environmental Protection Agency
ISWS	--	Illinois State Water Survey
ACP	--	Agricultural Conservation Program
RMS	--	Resource Management System
MSL	--	Mean Sea Level
F	--	Fahrenheit
MM	--	Millimeter
NPS	--	Non Point Source
T	--	Tolerance Soil Loss
in	--	inches
T.D.	--	Tube Diameter
PCB	--	polychlorinated biphenyls
BOD	--	biological oxygen demand
COD	--	carbonaceous oxygen demand
IPCB	--	Illinois Pollution Control Board
mg/l	--	millgram per liter
NTU	--	Nephelometric Turbidity Units
ug/l	--	micrograms per liter
ml	--	milliliter
mg/kg	--	milligram per kilogram

TED:ba/spl234c/1-64